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# STATE WATER CONSERVATION PROJECTS

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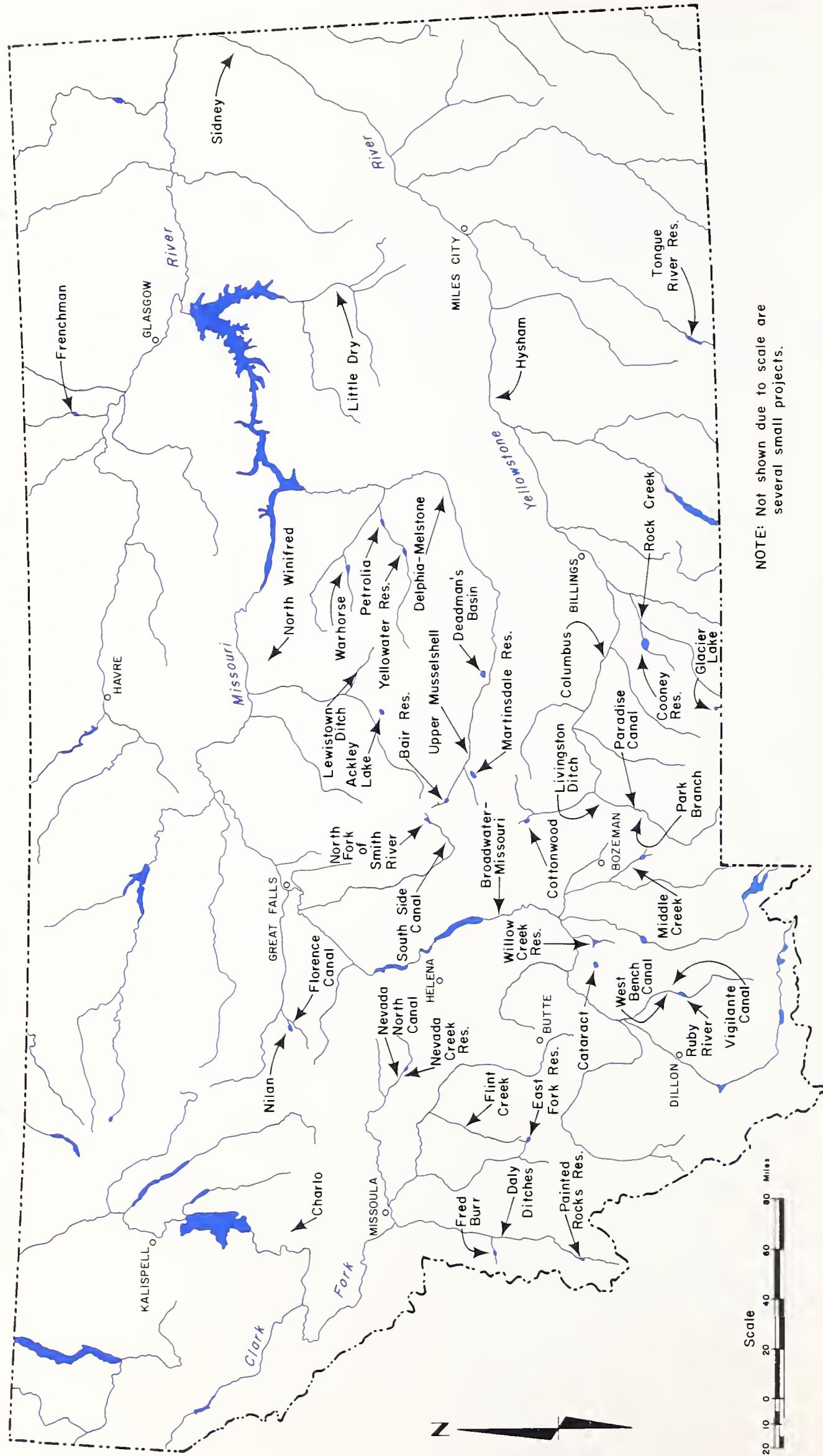
MONTANA DEPARTMENT OF NATURAL RESOURCES & CONSERVATION

WATER RESOURCES DIVISION

**DNRC**

JUL 24 1985

# WATER RESOURCES DIVISION MAJOR WATER CONSERVATION PROJECTS





# **STATE WATER CONSERVATION PROJECTS**

**MARCH 1977**

Engineering Bureau  
Water Resources Division  
Montana Department of Natural Resources and Conservation  
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NOV 9 1983



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Also included in this report are maps and reservoir storage curves for most of the projects discussed in chapter 4.

# ABBREVIATIONS USED IN THIS REPORT

ASCS	Agricultural Stabilization and Conservation Service
cfs	cubic feet per second
cu. yds.	cubic yards
DFG	Department of Fish and Game
EIS	environmental impact statement
FAY	firm annual yield
FHA	Farmers Home Administration
gpm	gallons per minute
HP	horsepower
MWRB	Montana Water Resources Board
O&M	operation and maintenance
PWA	Public Works Administration
RC&D	Resource Conservation and Development
R.C.M.	Revised Codes of Montana
REAP	Rural Environmental Assistance Program
RRD	Renewable Resource Development
R/W	right of way
SWCB	State Water Conservation Board
SCS	Soil Conservation Service
USBR	U.S. Bureau of Reclamation
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
WPA	Works Progress Administration



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# INTRODUCTION

Most water storage or distribution projects currently administered by the state were constructed by the State Water Conservation Board (SWCB), formed in 1935 during nationwide depression and serious drought. These projects were built with financial assistance from the federal Public Works Administration (PWA) as a means to provide emergency employment and to provide water conservation projects to help stabilize Montana's agricultural economy.

The state now owns over forty water conservation projects. The Water Resources Division of the Department of Natural Resources and Conservation is the state agency charged with administering them. Most of the projects are administered through a contractual agreement with the local water users association. These water marketing contracts require the association to repay the state its investment in the project and to collect and expend an operation and maintenance (O&M) charge in exchange for delivery of the water. To save money and more efficiently run the projects, most of the associations have agreed to operate the projects themselves, with the Department maintaining a supervisory capacity.

## State Liability

Because of deterioration with age, design deficiencies during construction, and insufficient or incorrect maintenance and repair after construction

was finished, many of the projects now require substantial and expensive rehabilitation. Although the projects made possible the successful development of many acres of irrigation, vastly improving the economy of some areas of the state, a few projects have deteriorated so seriously that the associations may be forced to endure extreme financial burdens to keep the projects functional. A few others no longer function at all.

There are several obvious examples of this deterioration. The spillway of Cooney Dam of the Rock Creek Project, for example, must be replaced, as must the spillways of Tongue River Dam and Nevada Creek Dam. Spillways of several other project dams need repair. Outlet tunnels of several dams, most notably those on the Painted Rocks, Tongue River, Nevada Creek, Ackley Lake, Yellowstone, and Middle Creek projects, are in frequent need of repair. There are miles of canal in need of lining and other forms of repair.

As the owner of these projects, the state has a tremendous potential liability. Should one of the deteriorated projects fail and cause property damage or death, the state could be sued. Under the terms of the water marketing contracts and Water Resources Act, Section 89-115, second paragraph, R.C.M. 1947, the settlement or award from such a lawsuit is chargeable to the local water users association, if one exists. Because a severe financial burden could then be placed on an association, the Department has asked the local associations to obtain liability insurance. The cost of one million dollars of liability coverage ranges from \$400 to \$800 per project. On a few of the smaller projects, this nearly doubles the annual O&M budget. Of eighteen dam project associations, nine have liability insurance policies, and of thirteen canal project associations, four have insurance. The Charlo Project, a domestic water supply, as yet has no coverage. The remaining projects owned by the state have no active associations; for these the state faces a direct liability should damages occur.

In its continuing program to improve the projects, the Department is attempting to rehabilitate the projects in immediate need of repair and to divest itself of any property interest in those projects in which future state involvement is not desirable. Representatives of the Department maintain frequent contact with the active water users associations by attending important meetings, such as annual stockholders meetings, and by annually inspecting dams. Associations are advised of maintenance, repair, operational, and budgetary needs. The Department is working with the associations and state and federal agencies to determine the best repair alternatives and to find financing for the repairs.

#### Repayment of the State's Investment

Since the beginning of the water conservation program in 1935, the state has invested \$13,773,730 in the major projects, in addition to a large amount of federal financing. At present-day costs, these projects would have cost many times that amount.

Because the original objectives of the water conservation program were to build water conservation projects and put people to work, recovery of the



state's investment received little consideration until recently. A host of problems encountered during design and construction of the projects resulted in the necessity to alter or repair some of the projects soon after they were constructed. As a result of these and other problems, the state has been unable to fully recover its investment on some projects under existing contracts. The Department has been trying to secure, under new contract, as much of the previously unsecured debt as possible.

At a request of the Legislative Auditor, the Engineering Bureau is completing critiques of each project. Each critique is to be a complete engineering, economic, and financial analysis of the project. It should identify actions needed to make a project structurally and financially stable and recommend the degree of future Department involvement. Alternatives available to the Department for each project include: (1) rehabilitating the project and retaining state ownership, (2) releasing the ownership of the project to the interested water users association, or (3) abandoning the project after taking measures to permanently eliminate all safety hazards. At this time, three critiques of major projects have been nearly completed (Broadwater-Missouri, Deadman's Basin, and Delphia-Melstone). Several minor projects have been abandoned or released.

Progress toward the rehabilitation of the projects and the completion of project critiques has been slow. The Department staff assigned to this task is too small, and the amount of funds available to loan for rehabilitation is extremely limited. Four engineers and three technicians from the Engineering Bureau are barely able to respond to emergencies and pressing situations as they arise; anticipated problems often cannot be solved before they become emergencies. A great deal of time is spent in finding federal funds to make the repairs. In the past, the associations have been able to obtain cost sharing from the federal Agricultural Stabilization and Conservation Service (ASCS) and the Resource Conservation and Development (RC&D) program. Low interest loans have been obtained from the Farmers Home Administration (FHA). The Department was permitted to loan \$220,000 from its own funds during the fiscal years 1976 and 1977 for rehabilitation. The budget for the next biennium is expected to be only \$188,000, a small amount compared to the cost of the anticipated repairs. For example, \$350,000 will be required (financing has already been obtained) to repair the outlet tunnel at Painted Rocks Dam; \$100,000 was expended to line two miles of small canal on the Petrolia Project; an estimated \$240,000 will be required to repair the Nevada Creek Dam spillway; \$1,900,000 is the estimated cost of repairing the Cooney Dam spillway; as much as \$28,000,000 could be needed to replace the Tongue River Dam spillway; and the cost of replacing the Republican Diversion Dam of the Daly Ditches Project would be approximately \$750,000.

## History

During its 33-year existence, the SWCB had the responsibility to construct, operate, and maintain water conservation projects. In 1967, the SWCB was replaced by the Montana Water Resources Board (MWRB) and the new agency took on several new water-resource-related activities in addition to



those of the SWCB. Emphasis was shifted from construction of water conservation projects to providing engineering services for local groups and water users associations, assisting in the maintenance of previously constructed projects, and conducting annual maintenance inspections. Responsibility for operation and maintenance of the projects was gradually shifted from the SWCB and the MWRB to the local water users associations over a period of several years until finally the state agency served only a supervisory capacity.

Upon reorganization of state government in 1971, the MWRB was replaced by the Department of Natural Resources and Conservation. The Centralized Services Division of the Department was delegated the responsibility to handle the accounting and billing for the projects, and the Engineering Bureau of the Department's Water Resources Division was delegated the responsibility to provide engineering services for water users associations, to assist the water users in the maintenance and reconstruction of existing projects, and to conduct an annual project inspection program.

The following chapters describe the current physical and financial condition of the projects and explain the nature of the Department's involvement in each project. They describe the annual inspection program conducted by the Department and explain some of the major problems encountered on the projects. They also describe what information is to be included in the project critiques and what progress the Department has made to date in implementing these directives and in completing the responsibilities handed down from the MWRB. The report is intended to be a reference handbook for use by Department employees, legislators, and other interested persons.

# CHAPTER I

## PROJECT CRITIQUES

In 1971 the Office of the Legislative Auditor completed an audit of the MWRB for the fiscal year ending June 30, 1970. A major portion of this report dealt with the administration of state-owned water resource projects, and the following recommendations were included:

"We recommend that the board:

- "1. Formulate a critique of each project under its jurisdiction.
- "2. Resolve the status of each project as dictated by each critique by either abandoning or repairing the various projects.
- "3. Establish operation and maintenance charges which are sufficient to:
  - a. Reimburse the state for past recoverable expenditures.
  - b. Finance future operation and maintenance.
  - c. Accumulate a reserve for contingencies."

According to the report the critique should include:

- "1. A factual determination of the past, present, and future direct and indirect benefits from each project.
- "2. A determination and evaluation of the reasons why revenue from operation and maintenance charges has been insufficient to support the full extent of operation, maintenance, and repair expenses.
- "3. An accounting of state expenditures on the project for operation, maintenance and repair, and the status of those expenditures insofar as repayment is concerned.
- "4. A determination of what additional maintenance and repair work is warranted for each project in terms of potential direct and indirect benefits to the water users and the state.
- "5. A determination of the various alternatives available to the board in recovering, writing off, or otherwise disposing of past state expenditures for operation and maintenance.
- "6. A determination of the most appropriate manner of accomplishing and financing operation, maintenance, and repair in the future for each project."

In 1972 the Water Resources Subcommittee of the Montana Legislative Council prepared and issued Report No. 53, entitled Water Resources, to the 42nd Legislative Assembly. With regard to the project critiques, the Montana Legislative Council recommended that a critique be formulated for each active project and also for those inactive projects in which title to land is vested in the state. Such critiques should include:

- "(a) Total state investment in the original construction of the project.
- "(b) Total state investment recovered to date through sale of water and value of unsold water reserves.
- "(c) Historical listing of state expenditures for project operation and maintenance and related repayment to date.
- "(d) Description of state-owned real or personal property attached to the project, including water rights, if any.
- "(e) A multi-use economic analysis to determine the viability of the state's interest in each project."



Responsibility for project critiques rests with the Engineering Bureau of the Department's Water Resources Division. The Bureau has expertise primarily in engineering and hydrology, but other Water Resources Division personnel with expertise in planning, economics, and soils are available to the Bureau.

A list of the kinds of information which may be included in a project critique is found in figure 1. Normally most of the items listed will be addressed to some extent in the critiques of the larger projects; however, some items may be deleted if it is determined that they will be of little value or not applicable to a particular project.

Critiques for each of the projects will consist of one of three types of reports. The most extensive, prefeasibility reports, will be undertaken only for larger projects needing the most in-depth analysis. These reports will include thorough engineering and economic investigations. Recommendation for future involvement of the Department in each project and suggestions for changes in the operation and maintenance practices or design of the project will be made.

The status of six of the projects will be outlined in review reports, which will include only limited field investigations and will recommend what, if any, future involvement the Department should have in each project.

Terminal reports are being prepared to describe the status of approximately fifty of the smaller projects for which in-depth investigations are not warranted because the state owns only right-of-way easements. Previous SWCB reports have included recommendations that the state divest itself of property interest in these projects. To do so, the Department may quitclaim the right-of-way easements or other property interest to the landowner or to an interested group such as the water users association. Such action eliminates further involvement by the Department in the project. Divestiture of a project is contingent upon action being taken to ensure the safety of the project and to maximize repayment of the state's investment. A project can also be abandoned. To abandon a project, the state ceases to operate, maintain, or otherwise have anything to do with the project. No other legal action is necessary. No project has been intentionally abandoned.

Table 1 lists the projects for which critiques are planned and indicates the status of completion of each critique. It is evident that progress has been slow; the charge to develop these reports was made in 1971 and 1972. Only a small staff is engaged in the process, and this staff must carry out other duties in addition to preparation of the critiques. The day-to-day administration of the projects has increasingly been shifted to the Engineering Bureau along with numerous special projects which have impeded progress on the critiques.

In general, for the higher-priority projects, either the critiques or related studies (such as RC&D projects) are in progress. Reports for three projects are essentially completed. Lower-priority critiques will be completed later as Department manpower and budget permit. Several items were considered in establishing priorities, including the physical condition

Figure 1: INFORMATION TO BE CONSIDERED IN PREPARING A CRITIQUE REPORT

I.	Project History	V.	Project Operation
II.	Hydrology		<ol style="list-style-type: none"> <li>1. Water rights held by the Department for the project</li> <li>2. Reservoir operation <ol style="list-style-type: none"> <li>a. operation plans presently available</li> <li>b. past operation criteria</li> <li>c. operation problems</li> <li>d. firm annual yield of reservoir</li> </ol> </li> </ol>
III.	Project Lands		<ol style="list-style-type: none"> <li>3. Canal operation <ol style="list-style-type: none"> <li>a. past water use records</li> <li>b. canal efficiencies</li> <li>c. comparison of use with water requirements</li> </ol> </li> </ol>
IV.	Project Structures	VI.	Project Economics
	<ol style="list-style-type: none"> <li>1. Soils classification</li> <li>2. Location and amount of irrigated and irrigable land</li> <li>3. Cropping patterns</li> <li>4. Crop water requirements</li> <li>5. Lands owned by the Department</li> <li>6. Right of ways and easements</li> </ol>		<ol style="list-style-type: none"> <li>1. Financial statement</li> <li>2. Project benefits <ol style="list-style-type: none"> <li>a. monetary benefits</li> <li>b. other benefits</li> </ol> </li> <li>3. Future spending by the Department</li> </ol>
	<ol style="list-style-type: none"> <li>1. Reservoirs <ol style="list-style-type: none"> <li>a. present storage capacity</li> <li>b. dam height, volume of fill, capacity and appurtenances</li> <li>c. condition of dam</li> <li>d. history of problems and repairs</li> <li>e. present problems</li> </ol> </li> </ol>	VII.	Project Impacts
	<ol style="list-style-type: none"> <li>2. Canals <ol style="list-style-type: none"> <li>a. map of the system</li> <li>b. list of the structures</li> <li>c. condition of canal and structures</li> <li>d. history of repairs and rehabilitation work</li> <li>e. present problems</li> </ol> </li> </ol>		<ol style="list-style-type: none"> <li>1. Economic</li> <li>2. Social</li> <li>3. Environmental</li> </ol>
	<ol style="list-style-type: none"> <li>3. Other Structures</li> </ol>	VIII.	Project Assessment
			<ol style="list-style-type: none"> <li>1. Need for additional water <ol style="list-style-type: none"> <li>a. more storage required</li> <li>b. more water rights required</li> </ol> </li> <li>2. Maintenance problems <ol style="list-style-type: none"> <li>a. solution</li> <li>b. cost of solution</li> </ol> </li> <li>3. Operation problems</li> <li>4. Need for more and/or better data <ol style="list-style-type: none"> <li>a. water measuring devices</li> <li>b. project inspections</li> </ol> </li> </ol>

TABLE 1

## PROJECT CRITIQUE STATUS

STATUS	PROJECT	COUNTY
Prefeasibility report essentially complete	Broadwater-Missouri Deadman's Basin	Broadwater Wheatland/Golden Valley/Musselshell
	Delphia-Melstone	Musselshell/Rosebud
Prefeasibility report partially completed, or related studies in progress	Columbus	Stillwater
	Daly Ditches	Ravalli
	Little Dry	Garfield
	Rock Creek	Carbon
	Sidney	Richland
Prefeasibility report planned	South Side Canal	Meagher
	Tongue River	Bighorn/Rosebud/Carter
	Warhorse	Petroleum
	Ackley Lake	Judith Basin
	Cataract	Madison
	Cottonwood	Park
	Flint Creek	Granite
	Fred Burr	Ravalli
	Frenchman	Phillips
	Hysham	Treasure
	Livingston Ditch	Park
	Middle Creek	Gallatin
	Nevada Creek	Powell
	Nevada North Canal	Powell
	Nilan/Florence Canal	Lewis and Clark
	North Fork of Smith River	Meagher
	Painted Rocks	Ravalli
	Paradise Canal	Park
	Park Branch	Park
	Petrolia	Petroleum
	Ruby River	Madison
	Upper Musselshell	Meagher/Wheatland
	Vigilante Canal	Madison
	West Bench Canal	Madison
	Willow Creek	Gallatin/Madison
	Yellowwater	Petroleum
Review report partially completed	Bainville	Roosevelt
	Big Dry	Garfield
	Green Mountain	Sanders
	North Winifred	Fergus
	Charlo	Lake



Table 1, continued

STATUS	PROJECT	COUNTY
Review reports planned	Hotchkiss	Rosebud
	Lewistown Ditch	Fergus
	Lisk Creek	McCone
	Theboe Lake	Teton
	Valentine	Fergus
Terminal reports planned or in progress	Big Horn Tullock	Treasure
	Brady Water Supply	Pondera
	Burgess	Richland
	Community Gravity	Sanders
	Highwood	Chouteau
	Red Butte Creek	Fallon
	Reder	Powder River
Terminal reports completed; projects not yet released	Camp Creek	Silver Bow
	Daniels	Daniels
	Outlook	Sheridan
	Sehm	McCone
	West Fork of Poplar	Daniels
	Wold	Dawson
Terminal reports completed; project released	Alexander	Garfield
	Armells Creek	Rosebud
	Bischoff	Carter
	Blyton	Wibaux
	Buckley	Richland
	Burnside	Richland
	Bushell	Wibaux
	Davis	Richland
	Fadness	Daniels
	Fatzinger	Dawson
	Findlater	Custer
	Fletcher	Richland
	Francis	Rosebud
	Hall	Custer
	Hawkinson	Garfield
	Jones	Custer
	Love	Custer
	Nickwall	McCone
	Nieser	Sheridan
	Noble	Custer
	Pardis	McCone
	Pierce	Dawson
	Red Horse	Garfield
	Richardson	Rosebud
	Riley	Fallon
	Ruffato	Richland
	Ryegate	Wheatland

Table 1, continued

STATUS	PROJECT	COUNTY
Terminal reports completed; project released (continued)	Shipley	Powder River
	Sinclair	Fallon
	Steffen	Dawson
	Straub	Fallon
	Sweetzer	Treasure
	Switzer	McCone
	Vincelette	Fallon
	Voss	McCone
	Williams	Garfield

of the water control structures and the financial status of the projects, particularly in those cases where large debts to the state will not be recovered under current contracts. In a few instances, local interest in rehabilitation of the project gave the project a higher priority than it otherwise would merit. The size of the project was also considered, and in general the larger projects are being studied first.

## CHAPTER 2

# FINANCIAL STATUS OF PROJECTS

The early construction program of the SWCB was financed principally through federal grants and the proceeds of Water Conservation Revenue Bonds sold to the federal government; projects financed in this way are called bonded projects. All the bonds except the Charlo Project bonds were purchased back from the Reconstruction Finance Corporation (a federal agency) at a favorable price in 1951 with funds appropriated by the legislature. The outstanding balance of the bonds in 1951 was nearly four million dollars, but the bonds were purchased from the Reconstruction Finance Corporation for only slightly over 1.5 million dollars. At that time, the bond refinancing costs were charged without interest to the bonded projects in proportion to each project's ability to pay. In 1974 the costs were reallocated in proportion to the outstanding balance of each bond at the time of bond purchase in compliance with the recommendations of the Legislative Auditor. Revenue generated from the bonded projects is deposited in the state's General Fund.

Nonbonded projects were financed primarily with state funds, occasionally with limited support from local sources.

The terms of repayment of the state's principal investment are defined by water marketing contracts and water purchase contracts. A water marketing contract is a two-party agreement between the Department and a water users association. It defines the obligation of the association to sell water from



the project, collect payments from the water users, and repay the state's investment in exchange for use of the project. To save money and more efficiently run the projects, most of the associations have agreed to operate the projects themselves, with the Department in a supervisory capacity. Under most water marketing contracts, there is no provision for an association to own a project when it is paid off.

A water purchase contract is a three-party agreement between the individual water user, the association, and the Department. It defines the conditions of water delivery to the water user and the terms of payment for the water. The amount paid by each water user is proportionate to the amount of water he receives and consists of a principal payment, which is applied toward repayment of the state's debt, and an O&M payment, which is used by the water users association for operation and maintenance of the projects.

On several projects, the state has extended loans to the associations for major repairs to the project. Repayment of these loans is accomplished either by renegotiating the original water marketing and water purchase contracts or by entering into a special repayment contract between the association and the Department.

Since most of the projects were undertaken as a means of creating employment and providing water conservation projects, long-term planning was often neglected in order to begin construction without delay. Full repayment of the state's investment was not necessarily an objective during the early years of the SWCB. Also, in order to promote the development of a project, many people agreed to purchase water who had no intention of continuing to buy water after the project became established. Consequently, many of the projects began operation on an impractical financial basis, a problem compounded by restrictive terms attached by the federal government. Not all of the projects have been self-sustaining, even though substantial credits were given to the projects through the favorable bond purchase price in 1951.

In compliance with the recommendations made by the office of the Legislative Auditor (see chapter 1), some efforts have been made to identify financial problems of the projects and to improve their financial status. One of the main reasons that the Department has failed to recover the state's investment in the projects is that sales of water from the projects have been less than originally anticipated. The Department has tried to secure more water sales in recent years, which, along with an increasing demand for water, has resulted in a substantial increase in water sales. Another reason for the poor financial condition of projects is that maintenance charges to the projects were accumulated by the SWCB without securing repayment contracts by which the state would recover its investment. In order to reduce the unsecured debts, the Department has tried to identify legitimate charges to the projects and to contract with the water users associations for repayment. This can be done either by renegotiating the water marketing contract or by entering a separate repayment contract. From July 1, 1970, to June 30, 1976, the Department increased the amount of funds under contract by \$2,222,676.99 by selling more water and by securing funds spent on the projects which were previously unsecured. During this time the Department spent \$575,349.40 for miscellaneous repairs and improvements on the projects, yielding a net overall

improvement of \$1,647,327.59.

The Daly Ditches Project, formerly a private irrigation project taken over by the state in 1942, presents a serious problem if the state expects to recover its investment. At the time of state takeover, existing water purchase contracts were assumed through which the state has been unable to recover its full operation and maintenance costs. An attempt by the Department in 1973 to assess all users a portion of the O&M costs based on the amount of water used resulted in a lawsuit which is still pending. Many water users are now paying their full proportionate share; several others are paying only the original contract rate. Until the lawsuit can be settled, the state's unrecovered investment in the project will continue to grow.

While the Department is making an effort to reduce the past unsecured debts through securing more water sales and repayment agreements with water users associations, consideration has been given to reducing expenditures on the projects to a minimum.

Status of the state's investment as of June 30, 1976 is outlined by project in table 2.

Water charges for several of the active projects, separated into principal, O&M, and special assessments, are listed in tables 3 through 5. Payments toward principal and repayment contracts, made at the end of a year of project operation, are used to retire the state debt. Special assessment and O&M payments are used by the water users association to meet the following year's expenses on the project. Most special assessments are essentially an O&M charge to pay off, over a period of several years, an investment made by an association for repairs to a project. They are listed separately to aid the association in billing and bookkeeping.

Not reflected in the financial statements of this report is that the state has acquired a large amount of real property through the water conservation project program. The state owns much of the project land. Dams, canals, and other project structures owned by the state are also property with financial value. In addition, the projects have increased the value of associated farmland and the production of associated farms, thus increasing the tax base. The benefit of these projects to the state outweighs the investment. However, the benefits could be offset somewhat by the potential liabilities the Department faces. Due to shortage of funds and manpower, the Department has been unable to correct all project deficiencies which present safety hazards and which could threaten the continued function of the projects. Funds of approximately \$100,000 are available each year to the Department to loan to Associations for smaller repairs, though large grants and loans will be needed to complete most of the needed repairs.

For these reasons, and because some associations have been unable or unwilling to assume the outstanding investment not secured by contracts, the Department is in the frustrating position of being virtually unable to put some of the projects on a sound financial basis. When the repayment of the state's investment is considered for all of the projects, the overall financial statement appears more favorable because projects on which the state's investment has been or will be repaid offset the projects whose financial standings are poor.



TABLE 2  
RECOVERY OF STATE INVESTMENT FROM INCEPTION TO JUNE 30, 1976

Project Name	Outstanding Investment 6/30/76 <sup>a</sup>	Receivables, 6/30/76			Status of State Investment, 6/30/76	
		Water Purchase Contract <sup>b</sup>	Repayment Contract <sup>c</sup>	Total	Potential State Revenue Exceeding Investment	Not secured by Current Contract
Ackley Lake	61,518.37	15,204.00	3,079.58	18,283.58		43,234.79
Broadwater-Missouri	(182,560.97)	76,269.06		76,269.06	258,830.03	
Cataract	246,965.61					246,965.61
Charlo	12,586.76	17,087.80		17,087.80	4,501.04	
Columbus	103,590.81	3,280.68		3,280.68		100,310.13 <sup>d</sup>
Cottonwood	42,600.81	43,891.70		43,891.70	1,290.89	
Daly Ditches	334,723.30	334,723.30 <sup>e</sup>		334,723.30		
Deadman's Basin	194,347.47	282,618.00	7,714.74	290,332.74	95,985.27	
Delphia-Melstone	1,110,522.86	193,521.95		193,521.95		917,000.91
Flint Creek	217,919.97	75,710.00		75,710.00		142,209.97
Florence Canal	182,195.79	40,544.46	7,400.00	47,944.46		134,251.33
Fred Burr	35,369.26	32,187.50		32,187.50		3,181.76
Frenchman	119,105.95	102,941.25		102,941.25		16,164.70
Hysham	421,761.13	310,098.37	27,521.43	337,619.80		84,141.33 <sup>d</sup>
Lewistown Ditch	1,624.73	1,630.89		1,630.89	6.16	
Little Dry	37,030.00		37,030.00	37,030.00		
Livingston Ditch	(13,328.55)	5,609.00		5,609.00	18,937.55	
Middle Creek	(30,556.89)	101,020.85		101,020.85	131,577.74	
Nevada Creek	102,651.69	66,953.25		66,953.25		35,698.44
Nevada North Canal	130,694.37	3,600.00		3,600.00		127,094.37
Nilan	318,503.07	342,999.00		342,999.00	24,495.93	
No. Fork of Smith River	(98,899.32)				98,899.32	
Painted Rocks	163,496.69					163,496.69
Paradise Canal	262,011.52	222,180.00		222,180.00		39,831.52
Park Branch	20,641.38	37,565.00		37,565.00	16,923.62	
Petrolia	430,699.46	232,802.00	32,510.33	265,312.33		165,387.13 <sup>d</sup>
Rock Creek	(57,709.82)	196,655.00	4,148.50	200,803.50	258,513.32	
Ruby River	(34,859.70)	48,620.00		48,620.00	83,479.70	
Sidney	381,324.29		336,609.41	336,609.41		44,714.88 <sup>d</sup>
South Side Canal <sup>f</sup>	16,481.97	18,000.00		18,000.00	1,518.03	
Tongue River	(37,719.19) <sup>9</sup>	765,534.73 <sup>h</sup>	12,341.00	777,875.73	815,594.92	
Upper Musselshell	205,246.58	240,952.00		240,952.00	35,705.42	
Vigilante Canal	248,981.76	115,342.50		115,342.50		133,639.26
Warhorse	2,603.06					2,603.06
West Bench Canal	47,664.27	42,168.00		42,168.00		5,496.27
Willow Creek	39,291.32	24,011.25		24,011.25		15,280.07
Yellowwater	(10,008.24)	8,400.00		8,400.00	18,408.24	
Total	5,026,511.57	3,982,621.54	468,354.99	4,450,976.53	1,864,667.18	2,430,702.22

<sup>a</sup>The outstanding investment is the state's total investment less the total revenue received as of June 30, 1976. Source: "Detail Project Ledger" on file with the Centralized Services Division, Department of Natural Resources and Conservation.

<sup>b</sup>Source: "Water Purchase Contract Ledger" on file with the Centralized Services Division.

<sup>c</sup>Source: "Repayment Contract Ledger" on file with the Centralized Services Division.

<sup>d</sup>A new contract is being negotiated.

<sup>e</sup>The outstanding investment as of 6/30/76, assumed to be fully repaid. However, a lawsuit was filed in District Court by one of the water users opposing the increased water rate necessary to recover the full outstanding debt. Full recovery of the outstanding investment will depend upon the court ruling.

<sup>f</sup>In accordance with a SWCB decision of 12/6/63, \$10,586.15 was credited to the project. Department legal expenses of \$2,380.30 incurred in assisting the South Side Water Users Association defend itself against a lawsuit were not charged to the Association.

<sup>9</sup>The cost of the feasibility study on the Tongue River conducted by Bechtel Corporation was not included.

<sup>h</sup>Does not include a contract with Montana Power Company for 4,175 acre-feet.

## WATER CHARGES: PROJECTS CHARGED BY THE ACRE-FOOT

Project	Charges per Acre-Foot by Year (dollars)									Total Amount of Water Sold (acre-feet/year)
	1969	1970	1971	1972	1973	1974	1975	1976	1977	
Ackley Lake	Principal O&M TOTAL	0.80 1.00 <u>1.80</u>	0.80 1.00 <u>1.80</u>	0.80 1.00 <u>1.80</u>	0.80 1.20 <u>2.00</u>	0.80 1.20 <u>2.00</u>	0.80 1.30 <u>2.10</u>	0.80 1.40 <u>2.20</u>	0.80 1.50 <u>2.30</u>	3,126
Broadwater- Missouri	Principal O&M Special Assess- ment TOTAL	0.91 0.76 0.22 <u>1.89</u>	0.91 0.76 0.22 <u>1.89</u>	0.91 0.91 0.22 <u>2.04</u>	0.91 0.86 0.00 <u>1.77</u>	0.91 0.86 0.00 <u>1.77</u>	0.91 0.55 0.00 <u>1.46</u>	0.91 0.55 0.00 <u>1.46</u>	0.91 0.65 0.00 <u>1.56</u>	29,217.75
Deadman's Basin	Principal O&M TOTAL	0.75 0.50 <u>1.25</u>	0.75 0.50 <u>1.25</u>	0.75 0.60 <u>1.35</u>	0.75 0.60 <u>1.35</u>	0.75 0.60 <u>1.35</u>	0.75 0.60 <u>1.35</u>	0.75 0.60 <u>1.35</u>	0.75 0.60 <u>1.35</u>	25,818 <sup>a</sup>
Flint Creek	Principal O&M TOTAL	1.00 1.00 <u>2.00</u>	1.00 1.00 <u>2.00</u>	1.00 1.25 <u>2.25</u>	1.00 1.25 <u>2.25</u>	1.00 1.50 <u>2.50</u>	1.00 1.50 <u>2.50</u>	1.00 1.50 <u>2.50</u>	1.00 1.95 <u>2.95</u>	14,745
Florence Canal	Principal O&M TOTAL	0.75 0.50 <u>1.25</u>	0.75 0.75 <u>1.50</u>	0.75 0.90 <u>1.65</u>	0.75 0.90 <u>1.65</u>	0.75 1.90 <u>2.65</u>	0.75 1.80 <u>2.55</u>	0.75 1.80 <u>2.55</u>	0.75 1.95 <u>2.70</u>	3,034
Fred Burr	Principal O&M TOTAL	2.50 0 <u>2.50</u>	2.50 0 <u>2.50</u>	2.50 0 <u>2.50</u>	2.50 0 <u>2.50</u>	2.50 0 <u>2.50</u>	2.50 0 <u>2.50</u>	2.50 0 <u>2.50</u>	2.50 0 <u>2.50</u>	515
Frenchman	Principal O&M TOTAL	0.75 0.25 <u>1.00</u>	0.75 0.25 <u>1.00</u>	0.75 0.25 <u>1.00</u>	0.75 0.25 <u>1.00</u>	0.75 0.25 <u>1.00</u>	0.75 0.25 <u>1.00</u>	0.75 0.25 <u>1.00</u>	0.75 0.25 <u>1.00</u>	6,450
Middle Creek	Principal O&M TOTAL	1.96 0.47 <u>2.43</u>	1.96 0.47 <u>2.43</u>	1.96 0.47 <u>2.43</u>	1.96 0.47 <u>2.43</u>	1.96 0.47 <u>2.43</u>	1.96 0.52 <u>2.48</u>	1.96 0.52 <u>2.48</u>	1.96 0.65 <u>2.61</u>	7,810



TABLE 3 continued

Project	Charges per Acre-Foot by Year (dollars)										Total Amount of Water Sold (acre-feet/year)
	1969	1970	1971	1972	1973	1974	1975	1976	1977		
Nevada Creek	Principal O&M TOTAL	1.05 0.95 2.00	1.05 0.95 2.00	1.05 0.95 2.00	1.05 0.95 2.00	1.05 0.95 2.00	1.05 0.95 2.00	1.05 0.95 2.00	1.05 0.95 2.00	1.05 0.95 2.00	7,045
Nilan	Principal O&M TOTAL	1.00 0.75 1.75	1.00 0.75 1.75	1.00 0.75 1.75	1.00 0.90 1.90	1.00 0.90 1.90	1.00 0.70 1.70	1.00 0.60 1.60	1.00 0.60 1.60	1.00 0.55 1.55	8,500
North Fork of Smith River	Principal O&M TOTAL	0.90 0.10 1.00	0.90 0.10 1.00	0.90 0.10 1.00	0.90 0.10 1.00	0.90 0.25 1.15	0.90 0.42 1.32	0.90 0.36 1.26	0.90 0.45 1.35	0.90 0.46 1.36	11,000
Painted Rocks	Principal O&M TOTAL	1.30 0.10 1.40	1.30 0.10 1.40	1.30 0.10 1.40	1.30 0.10 1.40	1.30 0.10 1.40	1.30 0.10 1.40	1.30 0.10 1.40	1.30 0.10 1.40	1.30 0.10 1.40	5,100
Rock Creek	Principal O&M Special Assess- ment TOTAL	1.00 0.15 0 1.15	1.00 0.15 0.10 1.25	1.00 0.15 0.10 1.25	1.00 0.15 0.10 1.25	1.00 0.15 0.10 1.25	1.00 1.20 0.10 2.30	1.00 1.25 0.10 2.35	1.00 1.25 0.10 2.35	1.00 1.25 0.10 2.35	17,750
Ruby River	Principal O&M TOTAL	0.56 0.24 0.80	0.56 0.24 0.80	0.56 0.24 0.80	0.56 0.24 0.80	0.56 0.24 0.80	0.56 0.46 1.02	0.56 0.40 0.96	0.56 0.50 1.06	0.56 0.65 1.21	25,065
Sidney	Principal O&M TOTAL	0.45 2.00 2.45	0.45 2.10 2.55	0.45 2.10 2.55	0.45 2.10 2.55	1.93 2.10 4.03	2.08 2.10 4.18	2.08 2.10 4.18	2.08 2.10 4.18	2.08 2.92 5.00	9,753
South Side Canal	Principal O&M TOTAL	0.20 0.30 0.50	0.20 0.30 0.50	0.20 0.30 0.50	0.20 0.30 0.50	0.20 0.30 0.50	0.20 0.30 0.50	0.20 0.10 0.30	0.20 0.36 0.56	0.20 0.20 0.40	3,750
Tongue River	Principal O&M TOTAL	1.30 0.37 1.67	1.30 0.32 1.62	1.30 0.32 1.62	1.30 0.32 1.62	1.30 0.28 1.58	1.30 0.28 1.58	1.30 0.32 1.62	1.30 0.41 1.71	1.30 0.43 1.73	35,729 <sup>b</sup>

Project	Charges per Acre-Foot by Year (dollars)										Total Amount of Water Sold (acre-feet/year)
	1969	1970	1971	1972	1973	1974	1975	1976	1977		
Upper Mussel- shell	Principal	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	19,201 ( & 32 acres)
	O&M	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
	TOTAL	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	
Vigilante Canal	Principal	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	13,090
	O&M	0.50	0.50	0.70	0.70	0.80	1.00	1.10	1.60	1.60	
	TOTAL	1.00	1.00	1.20	1.20	1.30	1.50	1.60	2.10	2.10	
West Bench Canal	Principal	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	8,475 ( & 517.38 miner's inches)
	O&M	0.45	0.55	0.55	0.60	0.70	0.70	0.90	1.00	1.00	
	TOTAL	0.75	0.85	0.85	0.90	1.00	1.00	1.20	1.30	1.30	
Willow Creek	Principal	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	9,023
	O&M	0.20	0.20	0.20	0.20	0.30	0.30	0.30	0.30	0.30	
	TOTAL	0.95	0.95	0.95	0.95	1.00	1.05	1.05	1.05	1.05	
Yellowwater	Principal	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2,000
	O&M	0	0	0	0	0	0	0	0	0	
	TOTAL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	

<sup>a</sup>Includes contracts No.249 for 50 acre-feet and No. 232 for 300 acre-feet which are pending cancellation by the association for nonpayment.

<sup>b</sup>Includes 5,290 acre-feet billed to T & Y Irrigation.

TABLE 4

## WATER CHARGES: PROJECTS CHARGED BY THE MINER'S INCH

Project	Charges per Miner's Inch by Year (dollars)										Total Amount of Water Sold (miner's inches)
	1969	1970	1971	1972	1973	1974	1975	1976	1977		
Columbus	Principal O&M TOTAL	1.56 2.05 3.61	1.56 2.05 3.61	1.56 2.05 3.61	1.56 2.05 3.61	1.56 2.05 3.61	1.56 2.05 3.61	1.56 2.05 3.61	1.56 2.64 4.20	1.56 2.64 4.20	1,468 <sup>a</sup>
Livingston Ditch	Principal O&M Special Assess- ment TOTAL	1.00 3.45 0.25 4.70	1.00 3.45 0.25 4.70	1.00 3.45 0.00 4.45	1.00 3.45 0.00 4.45	1.00 3.45 0.00 4.45	1.00 3.45 0.00 4.45	1.00 3.75 0.00 4.75	1.00 3.75 0.00 4.75	1.00 3.75 0.00 4.75	2,573 <sup>b</sup>
Paradise Canal	Principal O&M TOTAL	2.00 1.00 3.00	2.00 1.25 3.25	2.00 1.25 3.25	2.00 1.25 3.25	2.00 1.50 3.50	2.00 3.10 5.10	2.00 1.50 3.50	2.00 1.50 3.50	2.00 1.50 3.50	2,955
Park Branch	Principal O&M TOTAL	1.00 0.80 1.80	1.00 0.80 1.80	1.00 0.80 1.80	1.00 0.80 1.80	1.00 0.80 1.80	1.00 0.80 1.80	1.00 0.90 1.90	1.00 1.00 2.00	1.00 1.00 2.00	8,007

<sup>a</sup>State Land Department contract not included pending decision whether to cancel<sup>b</sup>Of this total, 388 miner's inches are prior-right water which pay O&M only

TABLE 5

## WATER CHARGES: PROJECTS CHARGED BY THE ACRE

Project	Charges per Acre by Year (dollars)										Total Amount of Water Sold (acres)
	1969	1970	1971	1972	1973	1974	1975	1976	1977		
Daly Ditches Project	Standard	3.00	3.00	3.00	3.00	5.26	6.68	8.07	8.56	9.07	Approx. 14,000
	Special Assess- ment TOTAL	0.50 3.50	0.50 3.50	1.00 4.00	1.00 4.00	0 5.26	0 6.68	0 8.07	0 8.56	0 9.07	
Delphia- Melstone	Principal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	5,710
	O&M Special Assess- ment TOTAL	2.25 4.50	2.50 4.75	2.50 4.75	3.00 5.25	3.00 5.25	4.00 6.00	4.00 6.00	4.00 6.00	4.00 8.00	
Hysham	Principal	1.75	0	0	0	1.75	1.75	1.75	1.75	1.75	5,715.4
	O&M Special Assess- ment TOTAL	4.00 7.10	6.65 7.50	6.65 7.50	6.65 7.50	6.65 9.75	7.15 9.75	7.15 9.75	9.75 12.35	9.75 12.35	
Petrolia	Principal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3,730
	O&M Special Assess- ment TOTAL	1.00 4.38	1.00 4.38	1.00 4.38	1.00 4.38	1.38 4.38	1.38 4.38	2.00 5.38	2.00 5.38	2.29 5.67	





## **CHAPTER 3**

# **PROJECT INSPECTION**

The Engineering Bureau of the Department in 1972 initiated a regular inspection program of state-owned water conservation project structures. This program has emphasized dam safety inspections, but other structures are checked as well. Hard hats, lights, ropes, poisonous gas detection instruments, pumps, an auxiliary air supply, and other equipment have been acquired to provide for the safety of personnel and to ensure adequate, useful inspections.

Twenty-three state-owned dams are now inspected annually by engineers from the Department and members of the local water users associations (see table 6). In the dam safety report written after each of these inspections, recommendations for maintenance or repair, if needed, are directed to the local association. If serious repairs are needed, the report is followed by correspondence and any assistance the Department can offer, such as technical expertise or help in obtaining financing. Inspection of project features other than dams, such as canals and associated structures, is completed as time permits. Special examinations are made when it is determined that annual inspections are not sufficient or when special studies such as project critiques are underway.

The Department also inspects some privately owned dams upon request when their safety is in question. Dam safety reports are written for these dams, including recommendations to the dam's owner for repair or maintenance. If

TABLE 6

STATE-OWNED DAMS INSPECTED BY THE DEPARTMENT  
OF NATURAL RESOURCES AND CONSERVATION

Name	Active Storage (acre-feet)	Structural Height (Feet)	Stream	Project	County
DAMS INSPECTED ANNUALLY					
Ackley <sup>a</sup>	6,140	54	Judith River	Ackley Lake	Judith Basin
Bair	7,029	100	N. Fk. Musselshell R.	Upper Musselshell	Meagher
Cataract	1,478	78	Cataract Creek	Cataract	Madison
Cooney	24,195	97	Red Lodge Creek	Rock Creek	Carbon
Cottonwood	1,400	56	Shields River	Cottonwood	Park
Deadman's Basin <sup>a</sup>	72,220	63	Musselshell River	Deadman's Basin/ Delphia-Melstone	Golden Valley/ Wheatland
Flint Creek	16,040	87	E. Fk. Rock Creek	Flint Creek	Granite
Fred Burr	516	50	Fred Burr Creek	Fred Burr	Ravalli
Frenchman	7,010	63	Frenchman Creek	Frenchman	Phillips
Glacier Lake	4,200	65	Rock Creek	Rock Creek	Carbon
Martinsdale <sup>a</sup>	23,105	96 and 49 <sup>b</sup>	S. Fk. Musselshell R.	Upper Musselshell	Wheatland
Middle Creek	8,027	110	Middle Creek	Middle Creek	Gallatin
Nevada Creek	12,414	118	Nevada Creek	Nevada Creek	Powell
Nilan <sup>a</sup>	10,092	44 and 34 <sup>b</sup>	Smith Cr. to Ford Cr. To Reservoir	Nilan	Lewis & Clark
North Fk. Smith R.	11,600	86	Smith River	N. Fk. Smith River	Meagher
Painted Rocks	32,362	143	W. Fk. Bitterroot R.	Painted Rocks	Ravalli
Petrolia	9,192	55	Yellowwater-Flatwillow	Petrolia	Petroleum
Ruby River	38,850	111	Ruby River	Ruby River	Madison
Tongue River	69,439	91	Tongue River	Tongue River	Big Horn
War Horse <sup>a</sup>	19,250	23	Ford Cr. & Buffalo Cr.	War Horse	Petroleum
Willow Creek	18,000	105	Willow Creek	Willow Creek	Madison
Yellowwater	4,242	37	Yellowwater Cr.	Yellowwater	Petroleum
DAMS INSPECTED PERIODICALLY					
Daly Lake <sup>a</sup>	120	12	Dam Creek		Ravalli
Stafford	330	27	Homestake Coulee		Fergus
Broadwater-Missouri	3,000	56	Missouri River		Broadwater
Christen Coulee	50	29	Christen Coulee		Richland
Sturgis	40	22	Sturgis		Richland

<sup>a</sup>Offstream storage<sup>b</sup>These reservoirs require two dams

a private dam is unsafe when inspected, the Department has no legal authority to force the owner to restore it to a safe condition; however, in that case, copies of the dam safety report are sent to the County Attorney of the affected county, who may take legal action to see that the structure is made safe. Table 7 lists private dams the Department has inspected.

### Problems Associated with Project Dams

All state-owned dams are earth- or rock-filled structures; a typical plan of these dams is shown in figure 2. The embankment, the main dam structure which effects the retention of the water, is a compacted earthfill with an impervious core of fine earth such as clay. Associated structures include spillways, outlet works, bridges, and drain systems. The location and size of these components vary due to the geographical location of the dam, physical restrictions, operating characteristics, fill materials, and design standards.

Outflows from the reservoir pass through an inlet structure, flow through a tunnel, and discharge through an outlet structure into a stilling basin and on downstream. Located in the outlet tunnel are two gates by which outflows are controlled; in most state-owned dams these are either two slide gates (figure 3) or a butterfly valve operated in combination with a gate valve (figure 4). In either system, the upstream gate is usually called the "emergency" gate and the other an "operating" gate, used to regulate the flow from the reservoir. The emergency gate is used to shut off the flow when repairs are made to the operating gate or when the operating gate becomes inoperative.

The outlet tunnel, particularly the gates, the gate control apparatus, and the adjacent tunnel walls, is often the site of serious deterioration. Most of that damage is caused by a process known as cavitation, in which water moving rapidly from the confined area between the gates into the enlarged area of the transition zone below the operating gate encounters a decrease in pressure. When the pressure is reduced below the vapor pressure of water, the water boils, and vapor pockets are formed. These bubbles are carried along with the water until a region of higher pressure is reached, where they suddenly collapse. The water surrounding each of these collapsed bubbles rushes into the vacant space, colliding violently near the center of the pocket. The energy released is converted into an intense, short-range shock wave which is mostly responsible for the eventual failure of the surface material.

Unless periodic maintenance is performed, pitting from cavitation can accelerate rapidly, weakening the structure. In some cases, pieces of a gate or valve have pitted badly enough to require parts to be replaced. On other dams, pitted areas were welded with a nickel-silver welding rod. The repair method that has been least expensive and most effective is filling the pitted area with epoxy steel. The success of this method depends on proper surface preparation, application, and curing conditions. Although epoxy steel may also cavitate, it can be easily maintained on a yearly basis, and the water users can do the repairs themselves.



TABLE 7

PRIVATE DAMS WHICH HAVE BEEN INSPECTED BY THE DEPARTMENT OF  
NATURAL RESOURCES AND CONSERVATION

Name	Active Storage (acre-feet)	Structural Height (feet)	Stream	County
Lima Reservoir Dam	125,000	50	Red Rock River	Beaverhead
Joe Bowers Dam	Less than 50	20	Joe Bowers Cr.	Deer Lodge
Skyliner Corp. Dam	15	25	Elk Cr. & Spring	Lewis & Clark
Upper Fred Burr Dam	211	20	Fred Burr Cr.	Ravalli
Bear Creek Dam	15-18	35	Bear Creek	Lewis & Clark
Dreese Dam	154	32	Gooseneck Cr.	Stillwater
Clifford Gravelly Dam	115	60	Illinois Gulch	Powell
Tributary to Redwater River Dam	30	17	Tr. to Redwater River	McCone

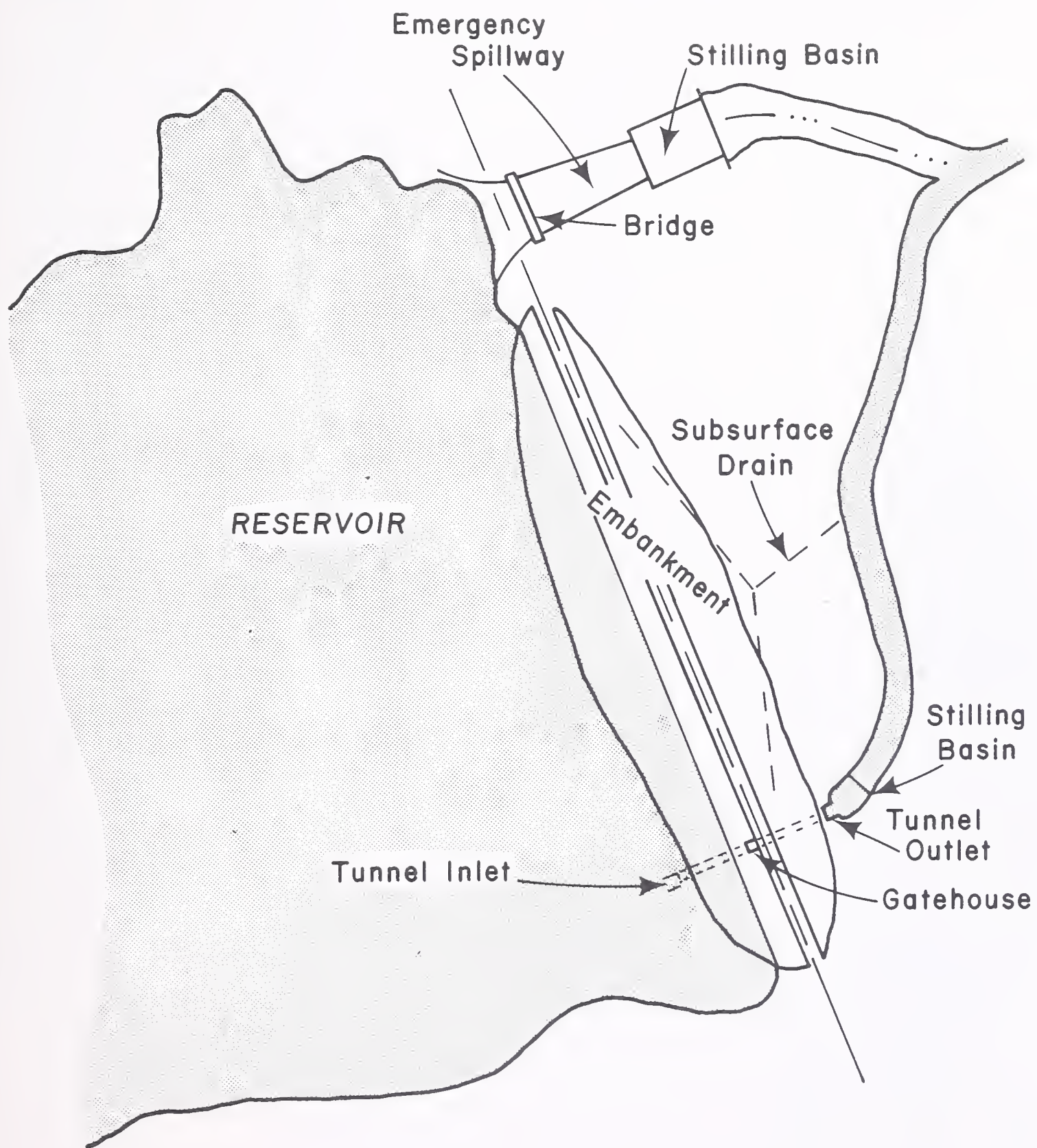


Figure 2: TYPICAL DAM AND RESERVOIR

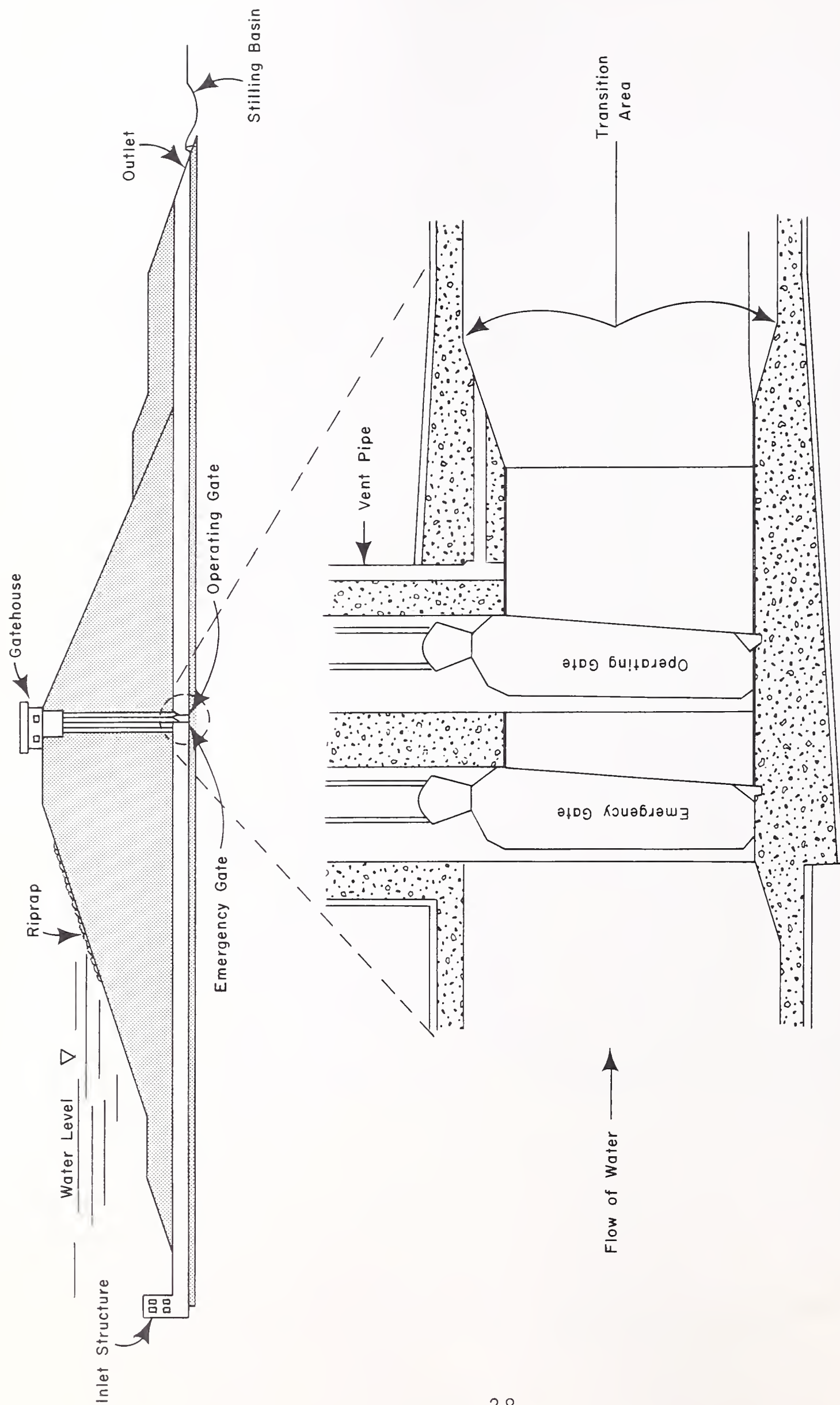


Figure 3: CROSS SECTION OF DAM AND SLIDE GATES



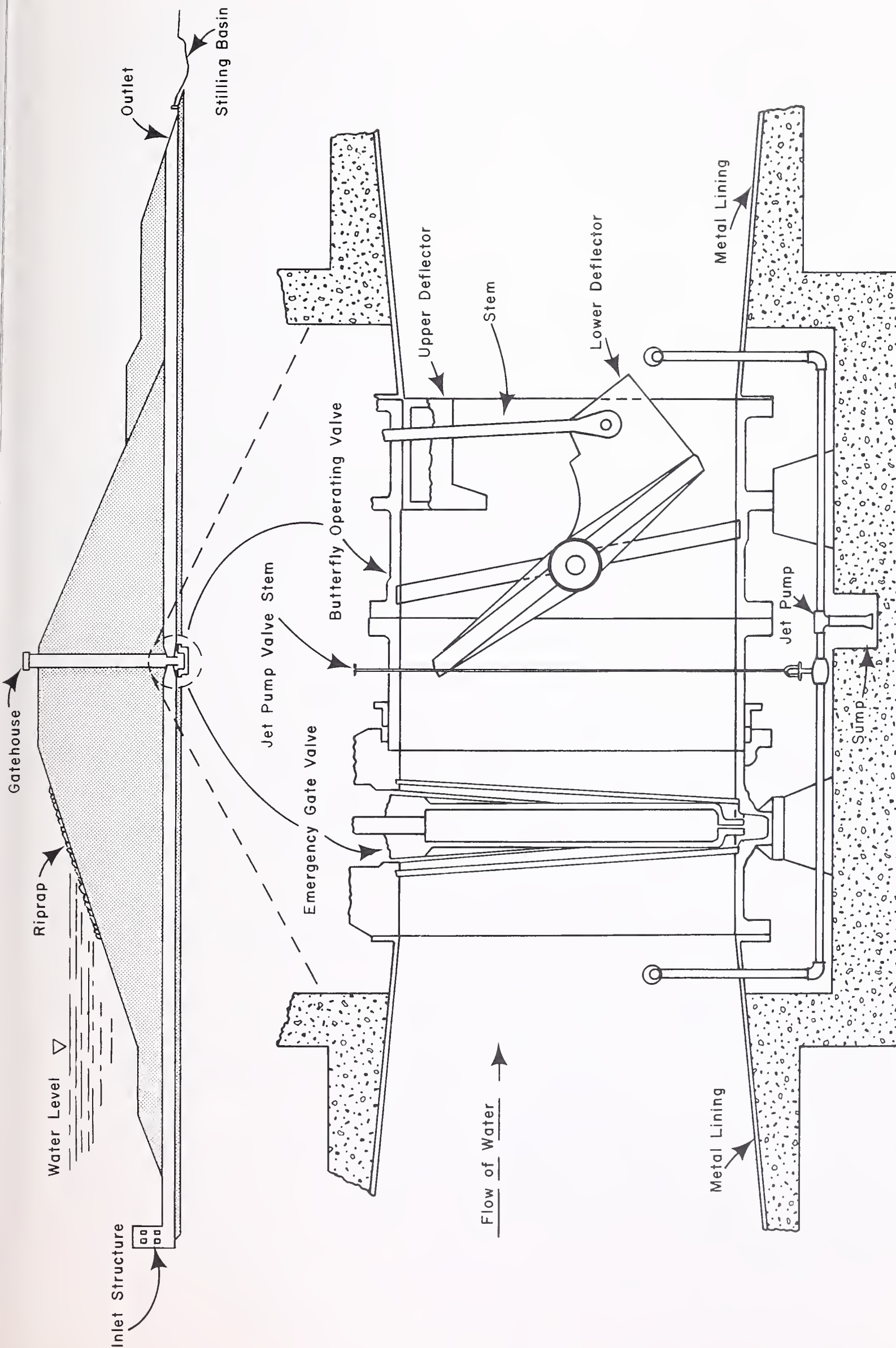


Figure 4: CROSS SECTION OF DAM, GATE VALVE, AND BUTTERFLY VALVE



Deteriorated concrete, another common deficiency encountered in the projects, is most serious on the emergency spillways and in the outlet tunnels and stilling basins. This deterioration, with symptoms including cracking, spalling, and disintegration, can result from many causes, including improper preparation and handling during construction, shrinkage upon drying, temperature stress, moisture absorption, corrosion of the reinforcement, chemical reactions, weathering, erosion (including abrasion and cavitation), improper curing temperature, and errors in design.

Diagnosis of the cause of deterioration can be difficult, and trained personnel are frequently needed to determine the most practical means of repair. Some methods of repair involve applying surface sealants, providing drainage, resurfacing with pneumatically applied concrete, applying epoxy, reinforcing the structure, or replacing the structure, depending on the cause and severity of the deterioration. The water users are able to perform small repairs themselves but must, with the approval of the Department, hire experienced help when major repairs are needed.

On some structures, further deterioration can be stopped by altering the operation of the dam. For example, continued deterioration of a spillway can be prevented by carefully controlling the operation of the reservoir. By maintaining a low water level until the runoff peak occurs, the frequency of use of the spillway can be reduced, thereby preventing unnecessary damage to the structure.

### The Inspection Program

A routine procedure is followed for most inspections. First, a date for the inspection is set, with the dam operators' approval. Personnel from the Department meet with members of the association at the dam. The emergency gate is closed, stopping all flow through the outlet. On some dams a bypass system (technically known as a jet pump) must also be shut off. The operating gate is then opened, allowing access to the emergency gate for inspection. In most cases the outlet tunnel must be dewatered by pumping to allow the inspector to enter.

Inside, he checks the gates and valves for cavitation damage, water tightness, and deterioration of seals. He determines whether the air vents are working and the protective coating on the outside of the gates is in place and in good repair. He inspects such components of the gates as pulleys, cables, pedestals, deflectors, guides, and bolts. The condition of the outlet tunnel itself is determined. Outside again, the inspector checks concrete structures, such as the stilling basin, outlet tube, trash racks, spillway, and control tower, for cracking, spalling, leaking, erosion, seepage, debris, scouring, poor operating condition, and deflection.

After the inspection of these items is completed, the emergency gate and bypass system are again opened, allowing water to flow through the outlet tube. The earth embankment is inspected for erosion damage, for the presence of large trees and brush, for debris accumulation on the upstream face, for animal burrows, and for indications of slippage or seepage. Riprap on the embankment

is checked to see that it adequately protects the upstream face from wave erosion. Drains which control seepage through the dam are checked to see if they are operating properly. Safety items such as ladders, railings, safety ropes, and safety belts are inspected; any electrical and natural gas hazards are noted and recommendations made for their mitigation.

These periodic inspections ensure that proper maintenance of the dam and its components is performed and that the dam remains safe so far as can be determined by visual inspection. Without them, deterioration could proceed unnoticed. Failure of a valve weakened by cavitation could result in a loss of control of the outlet flows, possibly causing flooding and endangering lives and property. Failure of a weakened spillway could result in loss of the dam during a flood. Either occurrence on an irrigation reservoir in spring could result in loss of irrigation water for at least one season, inflicting severe financial hardship on the water users.

Most of the repairs made as a result of the inspections are minor. It has been the Department's policy to recommend that these small maintenance repairs be completed soon after the inspection to prevent the structure from eventually reaching an unsafe condition. Minor deficiencies, if not corrected, can quickly develop into major problems that could necessitate replacement of the structure, involving a considerable amount of time and expense.

At present, these inspections consist only of on-site, visual inspections. The Department is not equipped at present to perform design investigations, which would include such elements as structural and stability analyses, hydrologic evaluations, and core drillings. Design investigations should be performed in the future to identify possible deficiencies not apparent on visual inspection.

The Department has made an effort to have members of the water users associations present during the inspections, since the water users are financially responsible for completion of any recommended repairs. Their presence during the inspection enables them to learn how the repairs should be made and to understand the importance of proper operation and maintenance, and, as a result, many associations have begun to participate more fully in the maintenance of the projects. The Department furnishes assistance for needed repairs in the form of information on material types, repair methods, and engineering design. Occasionally the Department provides financial assistance, usually consisting of loans to the local association.

The water users associations, because their assistance with the inspections and performance of recommended maintenance have enabled the Department to upgrade the safety of some of the dams considerably, must be given a portion of the credit for the success of the program. Despite the inspection program, however, serious deficiencies still exist on many of the projects (see chapter 4). Extremely high costs, difficult working conditions, shortages of manpower, and many other problems prevent these needed repairs from being quickly completed.



### Recent Major Repairs to Project Dams

In 1974, approximately \$60,000 of state funds and \$80,000 of association funds was spent for repairs of dams. Major repairs were completed on Painted Rocks Dam, Middle Creek Project, Nevada Creek Project, and Cooney Dam of the Rock Creek Project, including riprapping of some dams and extensive repairs to operating valves.

In 1975, repairs on dams included \$10,000 (association and federal funds) spent on outlet repairs to Cooney Dam of the Rock Creek Project and \$40,000 (reimbursable state funds) spent to repair cavitation damage to the Tongue River Dam.

During the 1975 high spring flows, the outlet tunnel of Painted Rocks Dam sustained considerable damage. Concrete reinforcing bars and a large section of steel plate were washed out, leaving in at least one area only natural rock as the water-carrying surface. The Department contracted Harza Engineering Corporation of Chicago to design repairs for the dam. Repairs were begun in the winter of 1976 and will be completed in spring of 1977; total estimated cost is about \$350,000.

Some of these repairs, especially those that involve closing the gate for an extended period to time, shutting off downstream flow, require an assessment of environmental impact under the Montana Environmental Policy Act, Section 69-6504, R.C.M. 1947. Proposed Repairs to Painted Rocks Dam (October 1976) and Proposed Repairs to the Tongue River Dam (October 1974), both environmental impact statements prepared by the Department, met the requirements of the Act. An agency impact determination, Proposed Repairs to the Cooney Dam, was written in March of 1975.

## CHAPTER 4

# PROJECT REPORTS

The reports on the following pages describe forty-six state-owned projects, significant recent activities of the Department and the water users associations, and the progress made towards completion of the project critiques.

A previous projects report, completed in 1961 by R. J. Kelly, Administrative Officer of the SWCB, is entitled Summary of Activities from Inception, January 22, 1934 to June 30, 1960 (State Water Conservation Board, Helena, March 1961). It provides a comprehensive history of construction, formation of water users associations, status of water contracts, and projects' financial status through 1960. The financial portion of the Kelly report was updated in 1965 by the SWCB.

In January 1973, Progress Report: Project Critiques was published by this Department. An accompanying volume, Supplement "A", published at the same time, included engineering data, maps, histories, and other technical information for the major projects. Both of these publications are still available from the Department.

Several of the projects have been known by two or more names over the years as a result of changes in administration and common usage. Alternative project names are indicated in the project reports.



A master list of all the projects, located in the Appendix, gives for each project the project number, drainage basin number (Department code), location (section, township, and range), and number of deeds and easements obtained by the Department for construction. A summary of the water rights filed for each major project is also given in the Appendix.

# Ackley Lake

The main feature of this project is Ackley Lake, an offstream storage reservoir created by the construction of an earthfilled dam near Hobson in Judith Basin County. The reservoir is supplied through a diversion canal from the Judith River; water is returned to the river through an outlet canal. Water distribution is accomplished through laterals from the outlet canal and through private diversions in the Judith River downstream from the outlet canal. Construction of the project, completed in 1938, was financed with a loan and grant from the PWA and with SWCB funds. Ackley Lake provides recreational as well as agricultural benefits.

Only limited involvement by the Department has been necessary in this project. Although minor repairs are needed from time to time, they are normally satisfactorily performed by the Ackley Lake Water Users Association during regular maintenance and repair. However, during a recent dam safety inspection, the asphalt lining was found to be pulling loose from the surface of the corrugated metal outlet pipe. The Association is seeking a suitable method of repair.

## Water Measurement

The Department maintains measuring stations on the inlet and outlet of the reservoir. The water is divided among the water users by a ditchrider without the aid of measuring devices. Monthly water surface elevations are recorded by the Department.

## Engineering Data

### DAM:

Storage	5815 acre-feet
Spillway	Width: 30'
	Capacity: 200 cfs
Gates	1 48" diameter slidegate. Wet tower
Height	41'
Length	3,514'
Type	Earth and gravel fill, 108,000 cu. yds.
Content Measuring Device	Tape in control tower

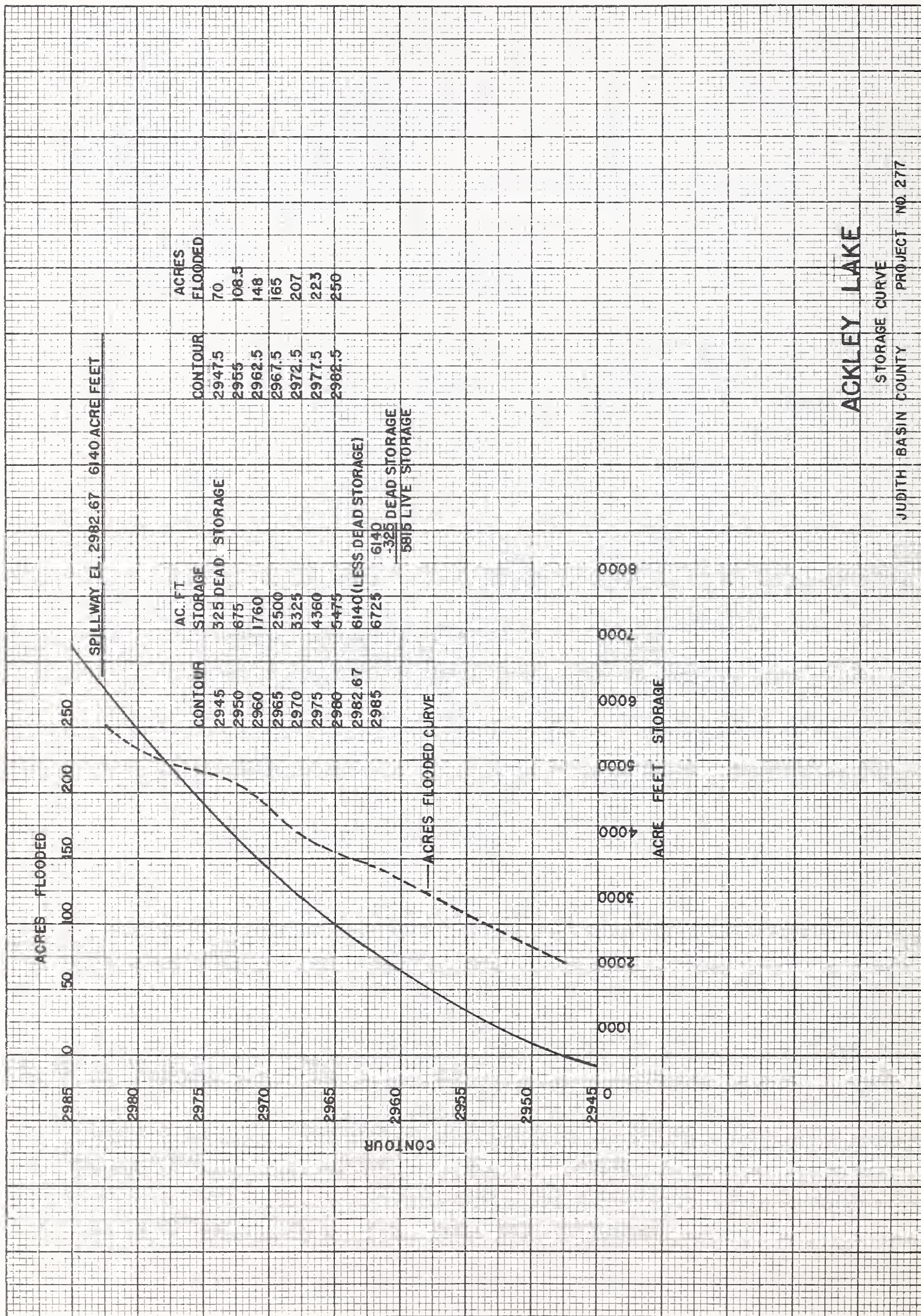
### CANALS:

Supply	6.72 miles
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		Capacity: 100 cfs
		Concrete headgate, concrete drop at reservoir
Outlet		4.68 miles
		Capacity: 62 cfs
Measuring Device		Water stage recorders above and below reservoir
R/W	Reservoir Pool	250 acres deeded
	Reservoir Land	233 acres deeded
	Canals	129.17 acres deeded
	Laterals	17.6 miles easements









# Bainville

The Bainville Project (also referred to as Bainville Flood Control Project and as Shotgun Diversion) is a flood-spreading irrigation project on Shotgun Creek near Bainville in Roosevelt County. It consists of two canals on opposite sides of Shotgun Creek designed to catch flood waters, both to give limited protection to the town of Bainville and to provide irrigation water for a small number of local farms. The east canal has a small reservoir for storage.

A field investigation, made in 1974, revealed that the project has fallen into disrepair. At that time only the upper reaches of the canals were being used, and there seemed to be little local interest in rehabilitation of the project. The project apparently has provided a limited amount of irrigation benefit to local farmers.

## Water Measurement

There are no measuring devices on this project.



# Big Dry

The Big Dry Project consists of a dam and canal on Big Dry Creek near Jordan in Garfield County. The project was completed in December 1938, but the dam washed out in March 1939. It was rebuilt, and the project was operated until 1944 when the dam washed out again. No further attempts have been made to rebuild the dam. Much of the trouble with this dam can be attributed to the loose earth formations that form the abutments at the ends of the fill and the poor foundation under the fill.

A field investigation was made in January 1975 to obtain information for a review report on the project. It was found that the gate control shaft in the dam presents a safety hazard to children and animals, but this problem should soon be eliminated when the Department fills the shaft with gravel.

The canal passes through the town of Jordan, creating unsightly conditions and mosquito breeding areas and preventing constructive use of the land. Some local citizens have asked that the Department release the right of way so the canals can be filled and the land put to good use.

## Water Measurement

There are no measuring devices on this project.





# Broadwater - Missouri

This project, located in Broadwater County, consists of a concrete diversion dam on the Missouri River and canals with a combined length of about forty-eight miles. The initial capacity of the main canal is 342 cubic feet per second (cfs). The construction of the project, financed with SWCB funds and a loan and grant from the PWA, was completed in 1940.

Most of the field work necessary for the completion of the project critique has been accomplished. Preliminary engineering investigations have been completed on problem areas, most of which are recorded in a report prepared by G.V.V. Rao, a student working under the Resources Development Internship Program sponsored by the Western Interstate Commission for higher Education. Rao's report, Critique of the Broadwater-Missouri Irrigation Project (August 1972), includes an assessment of existing structures and lists five situations requiring rehabilitation work. One major problem on the project is seepage from the main canal immediately below the diversion. Although a concrete lining project to correct the situation was proposed by the Broadwater-Missouri Water Users Association, the cost estimates by the Soil Conservation Service (SCS) and the Department were too high; a less permanent solution to the seepage problem is now being investigated.

Another problem, not covered in Rao's report, is a large steel pipe across the Missouri River which is losing its protective lining. Visual inspections of the pipe have been made, and it has been determined that extensive repairs will be needed. The pipe is rusting between the lining and the steel. The old lining and the rust will have to be removed and a new lining installed. The exterior also needs to be repainted. The Department is now working with the Association to determine a suitable means of repair. A contractor to do the repairs is now being sought.

To obtain right of way for the canals when the project was constructed, many agreements were made with farmers who already had water rights and private canals from side drainages. Such agreements require the Association to provide canal structures and services; some were stated ambiguously, resulting in a series of recent legal disputes over the actual terms of the agreements. The Department has tried to provide assistance in some of these disputes.

## Water Measurement

Measuring devices approved by the Directors of the Broadwater-Missouri Water Users Association are required for all turnouts. A program of carefully measuring water delivered at each turnout has been initiated by the Association and will be continued in the future. The Department maintains three con-

tinous recorders on the project.

### Engineering Data

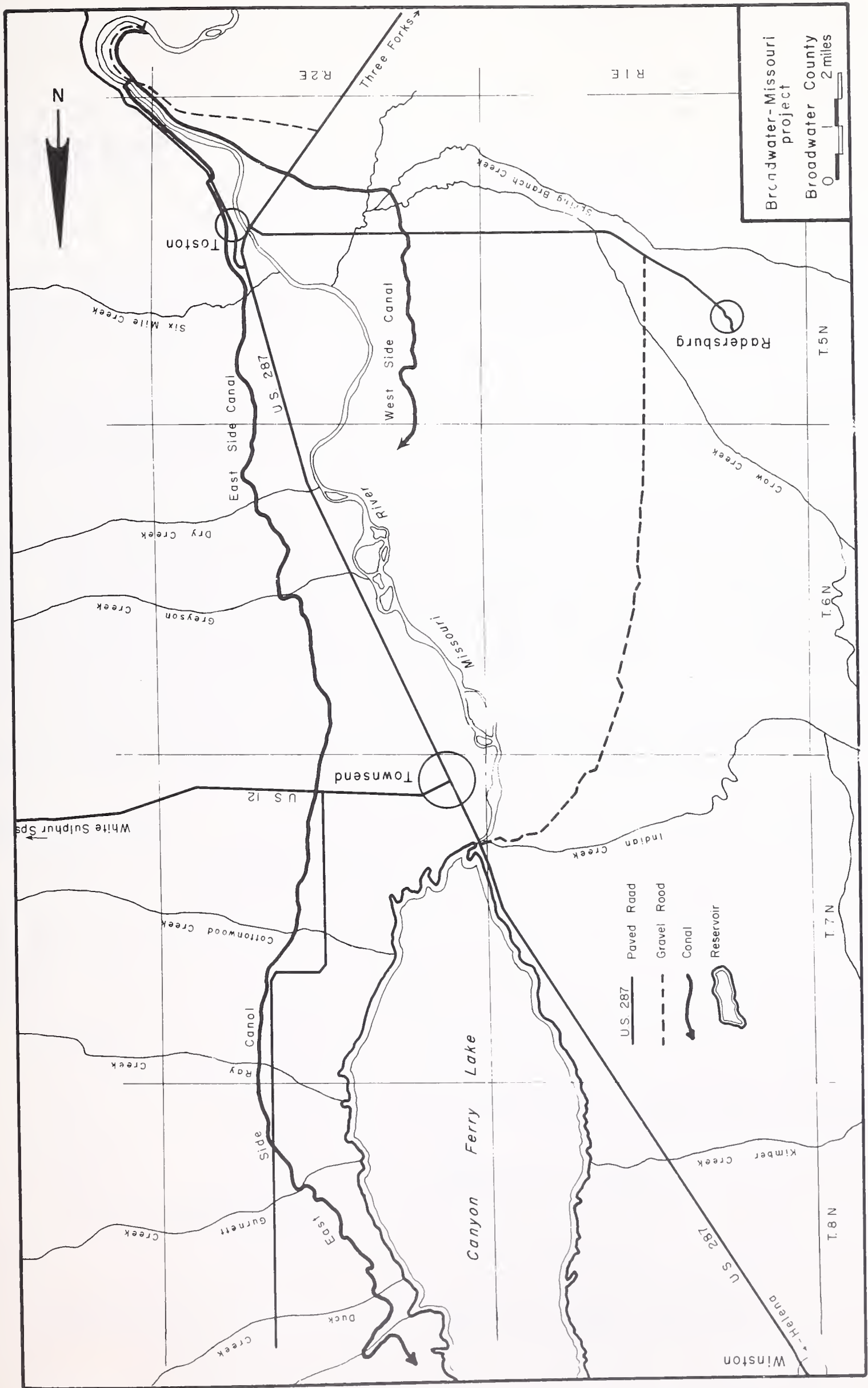
#### DIVERSION DAM:

Spillway	Width: 375'
Gates	Capacity: 50,000 cfs
Height	4 48' x 84" slide headgates to canal
	40' to Top of gravity section
	56' to Top of retaining wall
Length	705'
Type	Gravity overflow with stop planks,
	14,047 cu. yds.
Content Measuring Device	Staff gage on retaining wall

#### CANALS:

Main	1.5 miles
	Capacity: 342 cfs
	Concrete-lined section
West	12.4 miles
	Capacity: 90 cfs
	1,445' of 54" diameter siphon
East	34.3 miles
	Capacity: 262 cfs
	666.6' of 84" diameter pipe; 454.9' in
	4 suspended spans and 211.7' in
	ground. Crosses river and railroad
Measuring Devices	Water stage recorders

R/W	Diversion	49.18 acres
	Main	40.92 acres
	West	104.53 acres
	East	320 acres







# Cataract

This project consists of a dam and storage reservoir near Pony in Madison County. The reservoir, located on Cataract Creek, has a storage capacity of 1,478 acre-feet. The project, financed with state funds, was completed in 1959.

Severe leakage of the dam has prevented the reservoir from filling during most years. Past attempts to stop the leakage have failed. In 1973 a geologist investigated the leakage problem and presented alternative plans to alleviate the problem, all of which are too costly considering the present value of the water.

The project stores water during high runoff, but the water rapidly seeps out during the early summer, providing some benefit to members of the Cataract Water Users Association in the form of higher flows for a longer period of time. The reservoir was filled in 1975 by heavy spring runoff, and the spillway was used for the first time. The earthen portion of the spillway was heavily eroded. Continued use of the spillway could eventually threaten the safety of the dam if high flows last long enough. Care will be exercised to avoid the use of the spillway in the future.

Although this dam does not function in the way it was intended, it nevertheless receives occasional maintenance work by the Association.

## Water Measurement

There are no water deliveries.

## Engineering Data

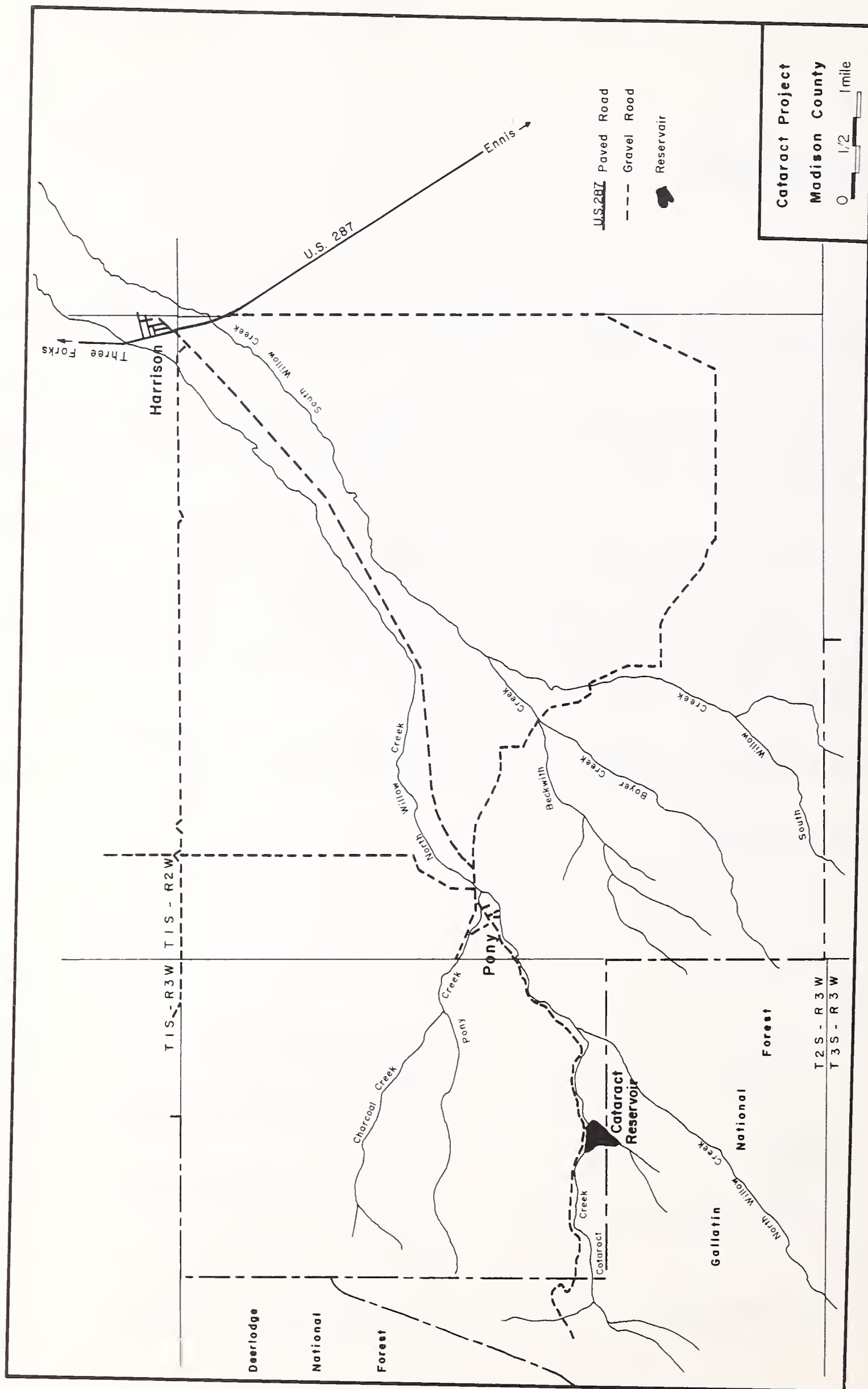
### DAM:

Storage	1,478 acre-feet
Spillway	Width: 20' Rock and concrete
Gates	2 30" diameter slide gates. Dry tower
Height	78'
Length	775'
Type	Earthfill, 120,600 cu. yds.
Content Measuring Device	Cable down dam face

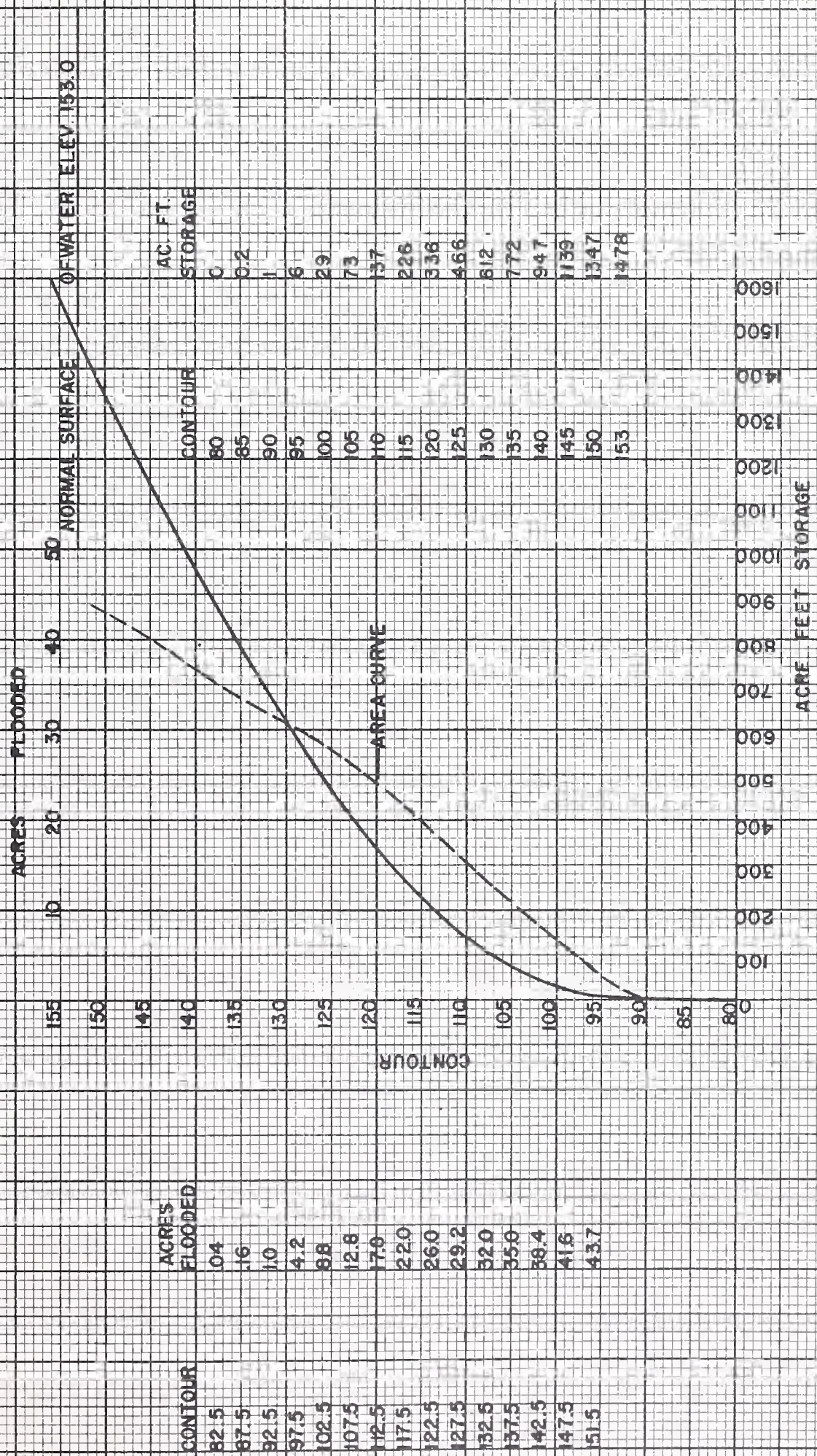
### CANALS:

Private Diversion

R/W Reservoir Pool	45 acres deeded and permit
Reservoir Land	7.8 acres deeded and permit







# CATARACT RESERVOIR

STORAGE CURVE  
MADISON COUNTY PROJECT NO 740





# Charlo

This project, which furnishes a domestic water supply to the town of Charlo in Lake County, consists of 1.8 miles of six-inch and four-inch wood stave pipe, a 40,000-gallon tank, and two wells. Water is pumped with two 100-gallon-per-minute pumps. In 1965 a new steel tank was installed, replacing the old wooden tank which was in a deteriorated condition. The project was completed in 1948.

The newer well, considered necessary for the continued growth of the community of Charlo, was drilled by the Charlo Water Users Association in 1975. Without this improvement of the water supply, the city would have continued to run short of water on occasion, and fire insurance rates would have increased. To finance the new well, the Department loaned the Association \$14,636.50. Contracts were renegotiated to include repayment of the loan. The Association will own the project when the state's investment has been repaid.

## Water Measurement

There are no measuring devices on the project. Each user pays for his water at a monthly rate which varies from user to user.



# Columbus

This project consists of a diversion canal on the Yellowstone River in Stillwater County. The Columbus Canal begins at the end of a privately owned canal, the Merrill Ditch. The original construction, financed with a loan and grant from the PWA and with SWCB funds, was completed in 1938.

In the fall of 1971, two siphons were constructed on the Columbus Canal at an approximate cost of \$140,000. Fifty-percent federal cost sharing was available to this project through the Beartooth Resource Conservation and Development (RC&D) Program, administered by the SCS. Under the directive of the Legislative Auditor, the Department has tried to secure this additional investment by including it in a new water marketing contract which would secure the state's entire investment in the project, including the old debt which was previously not secured under contract. The Association and the Department have been unable to agree on the old debt, and as a result a new contract has not yet been signed, although negotiations are still underway.

The Columbus Water Users Association has negotiated with the Montana Highway Department to correct some problems created by the construction of Highway I-90 through the project area, which required realignment of the canal and several other changes in the system. A wasteway installed by the Highway Department has resulted in problems with the operation of the canal and has caused erosion which threatens it. The Department of Natural Resources and Conservation designed changes in the structure which should eliminate most of the problems.

The water users recently placed riprap on the riverbank to protect the diversion and a part of the canal from erosion by the Yellowstone River.

## Water Measurement

A nonrecording measuring device measures water delivery to the canal. The water is divided among the water users by a ditchrider.

## Engineering Data

### DIVERSION:

Gates	2 48" x 48" slide gates
Measuring Device	None



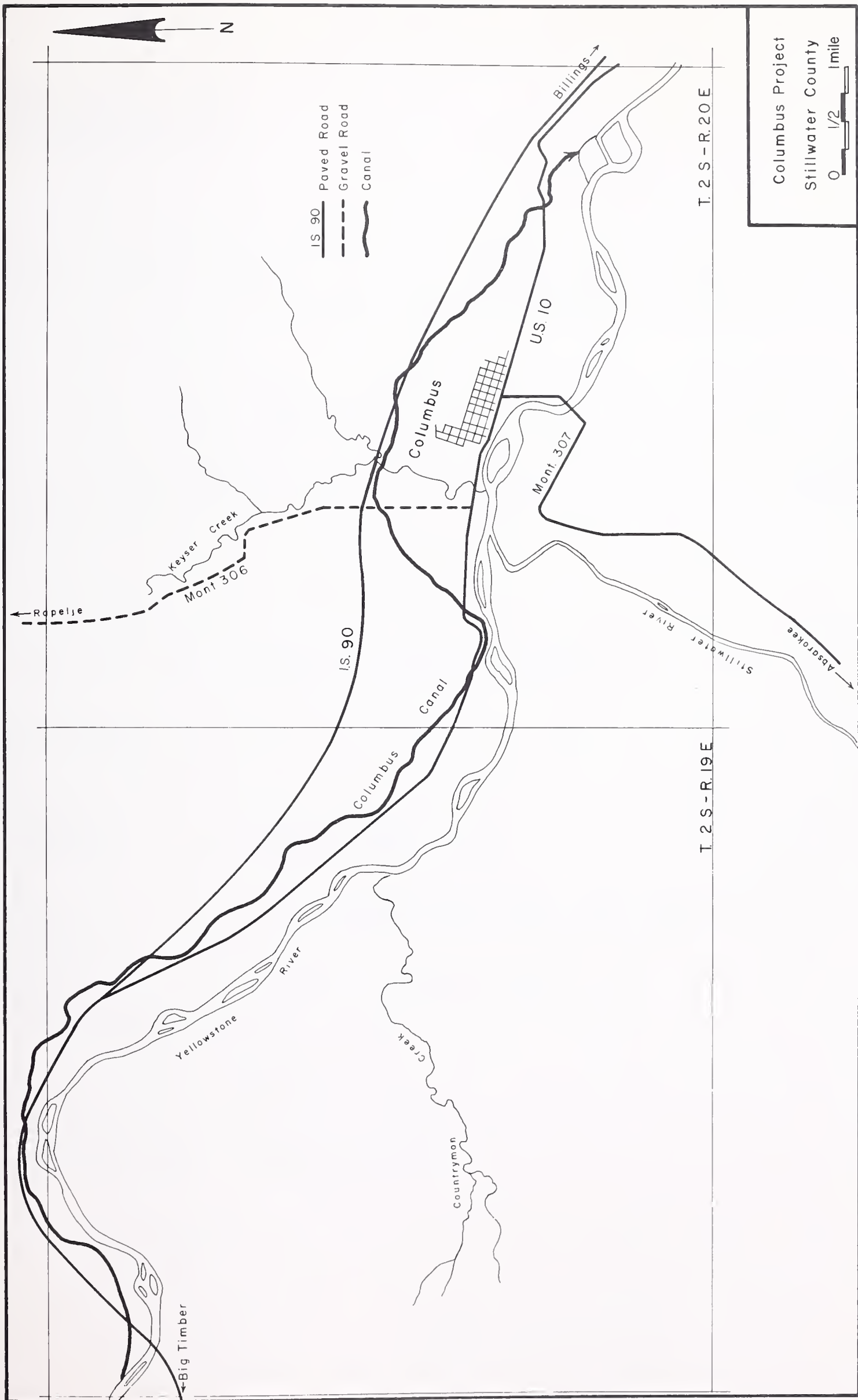
CANAL:

15.4 Miles

Capacity: 102 cfs

R/W Canal:

33.85 acres deeded plus R/W for  
Merrill Ditch





# Cottonwood

The Cottonwood Project, located near Wilsall in Park County, consists of a storage dam and reservoir on Little Cottonwood Creek. Water from this project is supplied to Shields Canal (private) through Potter Creek and the Shields River. Construction of the project was completed in 1953 and was financed with SWCB funds.

The spillway of the dam is in deteriorated condition. Investigation of the spillway floor to determine its structural stability is planned. The possibility of increasing the storage capacity of the reservoir by installing a radial gate on the spillway is being studied. In 1974, Shields Canal Water Users Association expressed interest in developing the reservoir for commercial trout production. This possibility is being investigated further by the Association.

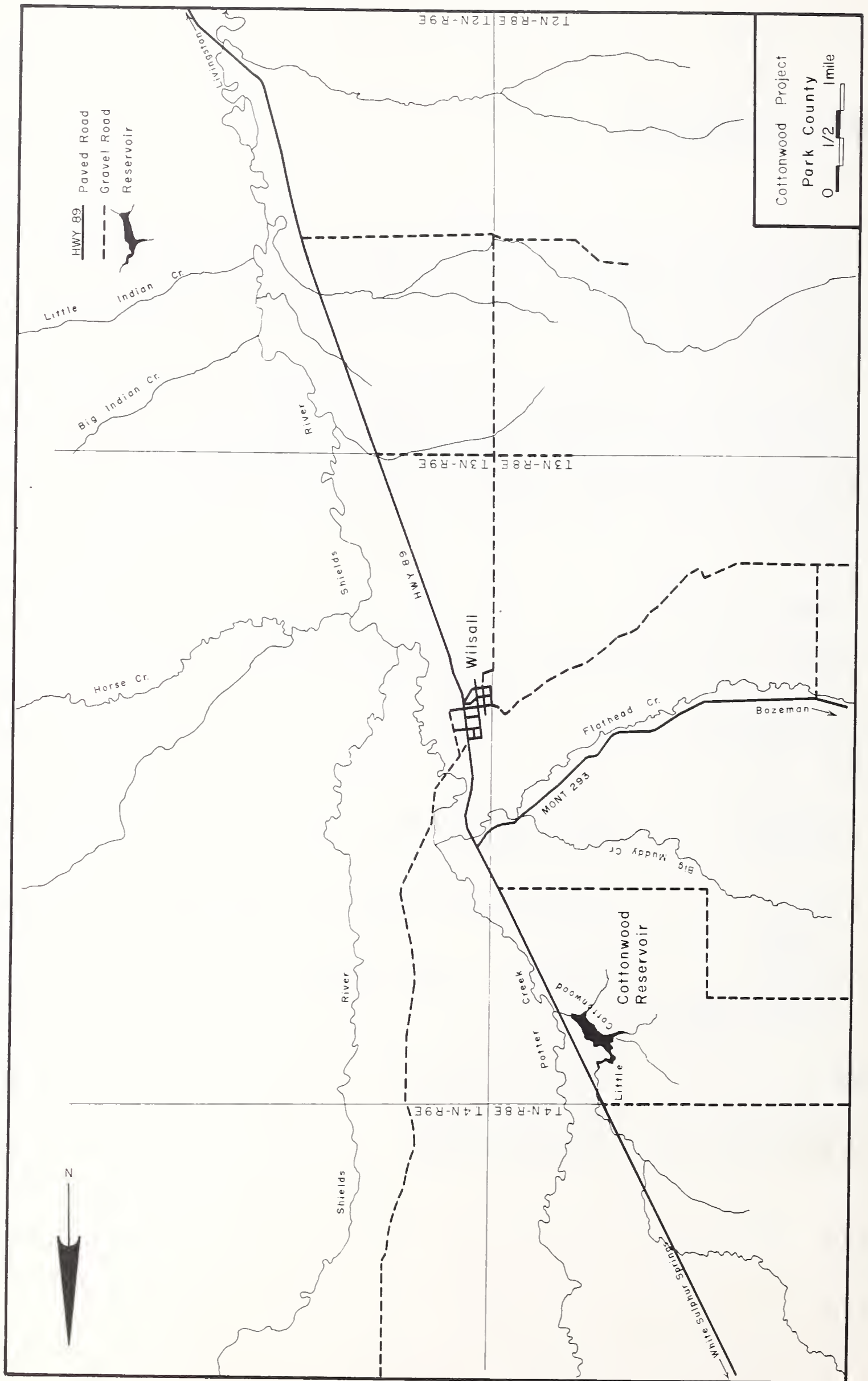
## Water Measurement

Water deliveries are made by a water commissioner.

## Engineering Data

DAM:		
Storage	1400 acre-feet	
Spillway	Concrete Width: 20'	
Gates	Capacity: 1,150 cfs	
Height	1 36" diameter slide gate. Wet tower.	
Length	37'	
Type	1,450'	
Content	Earthfill, 41,680 cu. yds.	
Measuring Device	Tape in tower	
CANALS:		
R/W	Private Diversion	
Reservoir Pool	175 acres deeded	
Reservoir Land	299 acres deeded	







Acres Flooded

100 200 300 400

AREA CURVE

2294

Contour	Area	Ac.Ft Storage
60	4.1	11
65	27.6	90
70	53.4	292
75	103.4	684
80	173.5	1377
84	285.5	2294
85	292.6	2563
90	404.1	4325

ELEVATION

86 84 82 80 78 76 74 72 70 68 66 64 62 60 58 56 54 52

ACRE FEET STORAGE

100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 2500

# COTTONWOOD RESERVOIR

STORAGE CURVE

PROJECT NO. 703 PARK COUNTY





# Daly Ditches

This project consists of several diversion structures and canals with a combined length of 110 miles. The major canals are Republican Ditch (originally constructed by the Republican Ditch Company prior to 1895), and Hedge, Ward, Skalkaho Hi-Line, and Girds Creek ditches (originally constructed by Marcus Daly prior to 1901). There are other smaller canals, distribution laterals, and waste ditches. The project was acquired by the SWCB in 1942 from the Ravalli Land and Irrigation Company, which could no longer guarantee a water supply for the land served. The Republican and Hedge ditches divert water from the Bitterroot River, the Ward and Skalkaho Hi-Line ditches divert water from Skalkaho Creek, and the Girds Creek Ditch diverts water from Girds Creek. The project is presently operated and maintained by field headquarters personnel of the Department.

When the state took over the project in 1942, water purchase contracts with individual water users were transferred to the state along with the project. These contracts called for delivery of water at a fixed price (\$3.00 per acre) and did not allow for the inflation of delivery costs. Execution of major repairs needed on this project has been stymied by lack of funds due to these unique water purchase contracts. The Department has been forced to operate this project at a substantial loss. Consequently, the legislature has been reluctant to invest much money in the Daly Ditches Project.

In 1973, the Department assessed all water users, including the users with old \$3.00 contracts, an equitable share of the principal and operation and maintenance costs of the project. Several of the old contract holders agreed to pay in full, but several more refused. The largest water user, Bitterroot Stock Farm, Inc., filed a civil action involving an injunction preventing the Department from enforcing the larger assessment and requesting 2.5 million dollars in the event that the agreements cannot be specifically performed. The lawsuit, now pending, is expected to be tried later this year. The Department's position is that the contracts are either void or allow for an increase in rates. Meanwhile, a large number of water users have been paying only \$3.00 per acre.

In 1975, contracts not paid by the due date of January 29 were cancelled. The cancelled water users were allowed to enter into the new contract which requires the water user to pay his share of operating expenses. Contracts entered during the past few years allow the Department to adjust the water rates to meet delivery costs, which in 1976 were \$9.07 per acre.

A complete rehabilitation program for the project was planned by the Department in 1972 with the assistance of the SCS and USBR. The rehabilitation program includes replacement of the Republican Diversion Dam and replacement of all those canal structures expected to fail within the next fifteen years. Several smaller structures are being repaired or replaced each year as money becomes available in the Department's budget, but progress has not been sufficient to keep ahead of problems that occur due to deterioration of the project.



For rehabilitation of the larger structures, financial assistance may be available in the form of a fifty-percent grant through the RC&D program and a low-interest loan for the remainder from the Farmers Home Administration (FHA). Thus far, it has not been possible to take advantage of this assistance partly because repayment of an FHA loan cannot be secured under the existing water purchase contracts.

The Republican Diversion Dam, an old, wooden structure which has deteriorated to an irreparable condition, is one of the larger structures included in the rehabilitation plan. Temporary repairs failed to withstand the flood in spring of 1974, and part of the structure was lost. Emergency repairs in spring of 1975 have kept the remaining parts of the structure functional thus far; it is hoped the structure will last until some source of funds can be found to finance a new diversion dam. If the dam fails, the water supply to several thousand acres of land will be substantially reduced until the structure can be replaced.

### Water Measurement

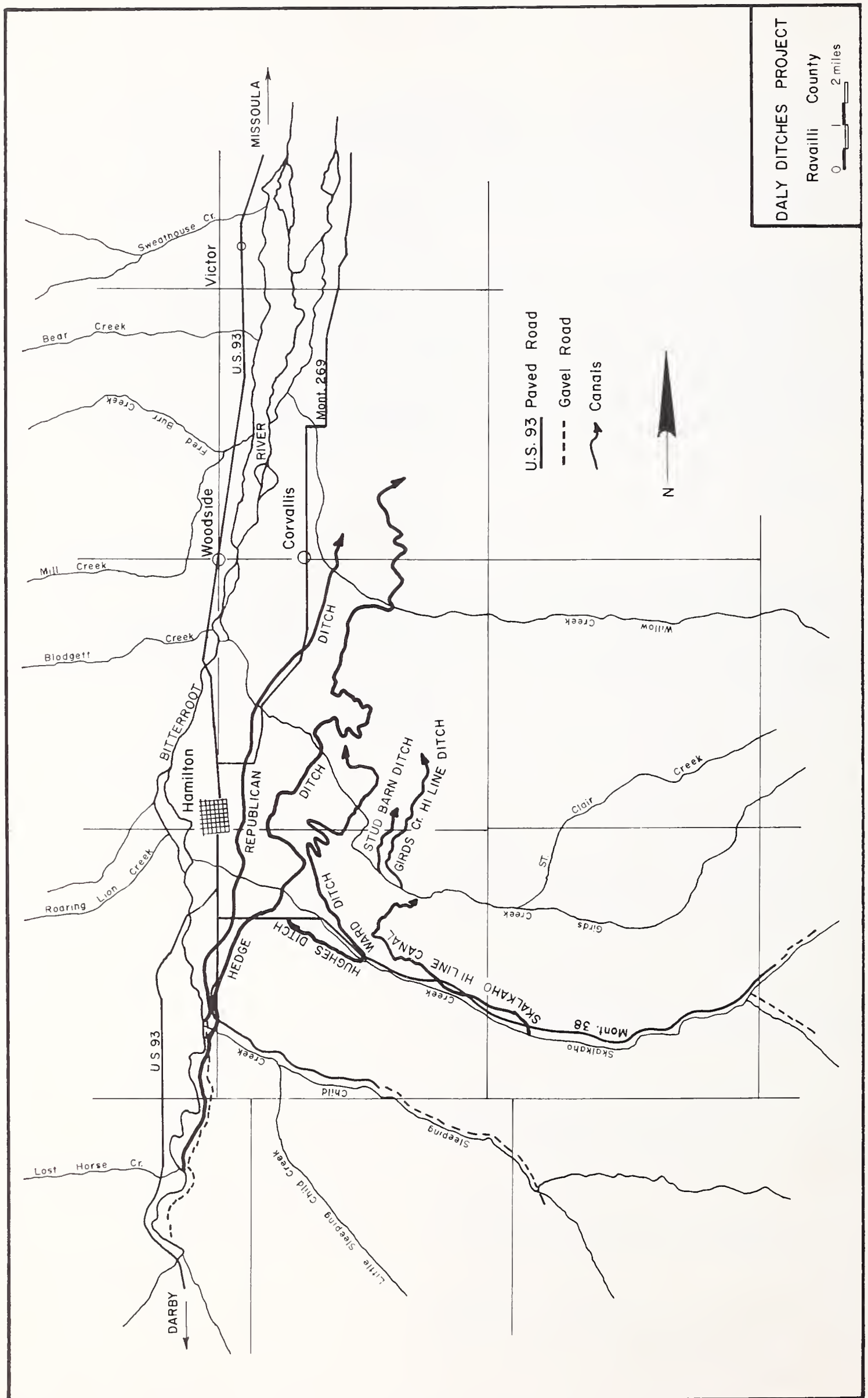
Water in the canals is measured at three Department gaging stations. A U.S. Geological Survey (USGS) gaging station on Skalkaho Creek helps measure the interchange of water between the project and the creek. All turnouts are measured by Department ditchriders with the aid of Clausen's rules, portable measuring rules for use on weirs.

### Engineering Data

#### CANALS:

Hedge	23 miles Capacity: 125 cfs Wood diversion dam and concrete head- gate
Republican	13 miles Capacity: 150 cfs Wood diversion dam and concrete head- gate
Ward	8 miles Capacity: 75 cfs Wood diversion and headgate
Skalkaho	6 miles Capacity: 50 cfs Concrete diversion and headgate
Girds Creek	7 miles Capacity: 20 cfs Wood diversion and headgate

Waste	3 miles Capacity: 50 cfs Wood headgate
Rim	3 miles Capacity: 50 cfs Wood headgate
Studbarn	1 1/2 miles Capacity: 40 cfs Wood headgate
Snake Creek	2 miles Capacity: 17 cfs Wood headgate
Hughes	4 miles Capacity: 35 cfs Wood headgate
Thompson	2 miles Capacity: 20 cfs Wood diversion and headgate
Reeser	2 miles Capacity: 15 cfs Wood headgate



# Deadman's Basin

Deadman's Basin is an offstream storage reservoir near Ryegate in Golden Valley and Wheatland counties. The project was constructed through the joint efforts of the SWCB, the counties of Golden Valley, Wheatland, and Musselshell, and the Works Progress Administration (WPA). The project was mainly financed with a loan from the Reconstruction Finance Corporation and with SWCB funds. In 1941 the project was completed.

Water is diverted from the Musselshell River to the reservoir via an 11.5-mile supply canal and is released through two outlet canals: the Careless Creek Canal and the Barber Canal. The many structures along these canals include drops, turnouts, and checks. Water stored in the reservoir during the spring runoff is released to downstream water users during the summer months when river flow is insufficient to supply irrigation water. The estimated firm annual yield of the reservoir is 34,000 acre-feet, of which 25,563 have been contracted by the water users. The remainder of the available water is lost in transporting the contracted amount. A moratorium on water sales from Deadman's Basin has been enforced since 1973 in hopes of encouraging downstream water purchases on the Delphia-Melstone Project, which is currently not fully developed. No additional water has been sold during this period.

The project critique on the Deadman's Basin Project has been essentially completed and has yielded the following conclusions. First, even though the firm yield of the reservoir is not contracted for, it is already being used by the project to supply delivery losses in the system. Therefore, there is no additional water available for sale on the project. Second, this project is in a good financial posture and will return to the state more than it originally invested in the project. Third, there are many structural deficiencies on this project which, if left untended, could result in loss of use of parts of the project. Finally, leakage of water from the outlet canals has caused salt accumulation and permanent wetting of many acres of land below the dam. This leakage could be corrected with better operation and some diking of the outlet pond.

## Water Measurement

All the canals are measured at four Department gaging stations. Water is turned into the Musselshell River and is diverted by state and private canals and pumps. Because most river diversions are not measured, the extent of private water rights in the river is unknown. River flows are monitored by USGS gages at Ryegate, Roundup, and Musselshell. Monthly reservoir elevations are recorded by the Department.



## Engineering Data

### DAM:

Storage	76,900 acre-feet
Spillway	Width: 30'
	Capacity: 1,000 cfs
Gates	2 60" x 60" Slide gates. Wet tower
Height	63'
Length	1,360'
Type	Earthfill with 2,950' dyke
Content Measuring Device	Tape in tower

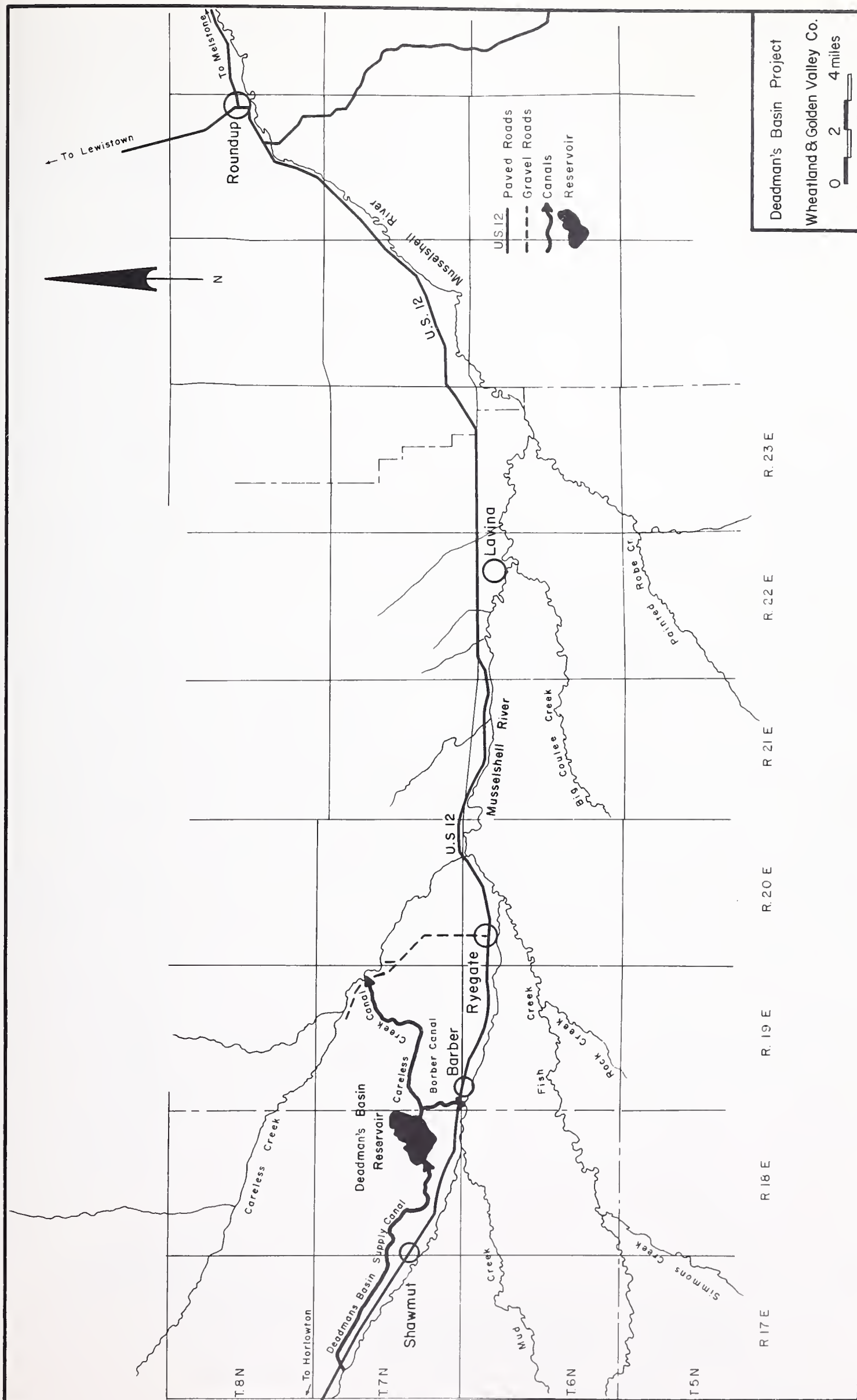
### CANALS:

Supply	11.49 miles
	Capacity: 600 cfs
	Concrete diversion and headgate

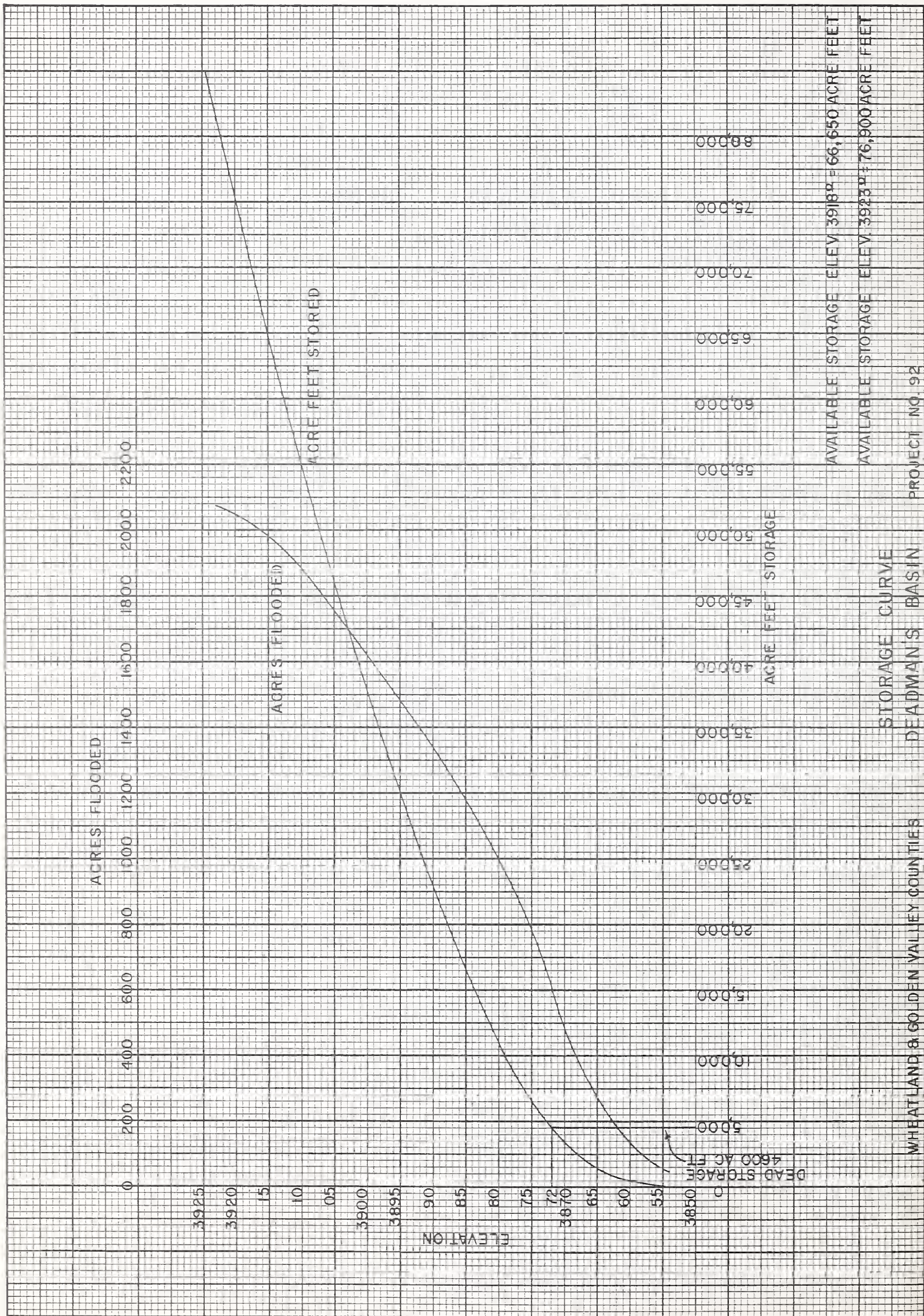
Careless Creek	9.50 miles
	Capacity: 344 cfs
	Concrete headgate

Barber	2.85 miles
	Capacity: 200 cfs
	Concrete headgate (5' x 14' radial)
Measuring Device	Water stage recorder on all canals

R/W Reservoir Pool	2,000 acres deeded
Reservoir Land	175 acres deeded
Canals	
Supply	723.34 acres deeded
Careless Creek	134.40 acres deeded
Barber	70.84 acres deeded
Wasteway	59.56 acres deeded









# Delphia-Melstone

This project is located in Musselshell and Rosebud counties near Melstone. It consists of the Delphia Canal, the Melstone Diversion Canal, and the North and South canals. The Melstone Unit was completed in 1949, and the Delphia Unit in 1955.

This project serves approximately 5,700 acres. The project's water comes from a 6,687-acre-foot purchase from Deadman's Basin Reservoir and from a Department-held, 250-cfs water right from the Musselshell River before June 15th of each year. These sources provide only two acre-feet per acre now irrigated by the project. Originally, this project was designed to serve approximately sixteen thousand acres; however, not all of these lands are irrigable, nor is there enough water if they were. A moratorium on the sale of water from Deadman's Basin Reservoir, imposed in 1973, provided for purchases of water only by the Delphia-Melstone Project to more fully utilize the facilities. The purpose of this action was to attempt to recover a portion of the large unsecured debt currently assessed to this project as a result of underdevelopment. No water was sold by the Delphia-Melstone Project during this period.

The critique report for the Delphia-Melstone Project, essentially completed in conjunction with the Deadman's Basin critique, includes several conclusions. First, a lack of water on the project will discourage future expansion unless additional storage is provided, and at this time building storage is uneconomical. Second, the state is not likely to recover a significant portion of its investment above the present projected recovery. Finally, several small maintenance items should be attended to in order to maintain the project in good operating condition.

## Water Measurement

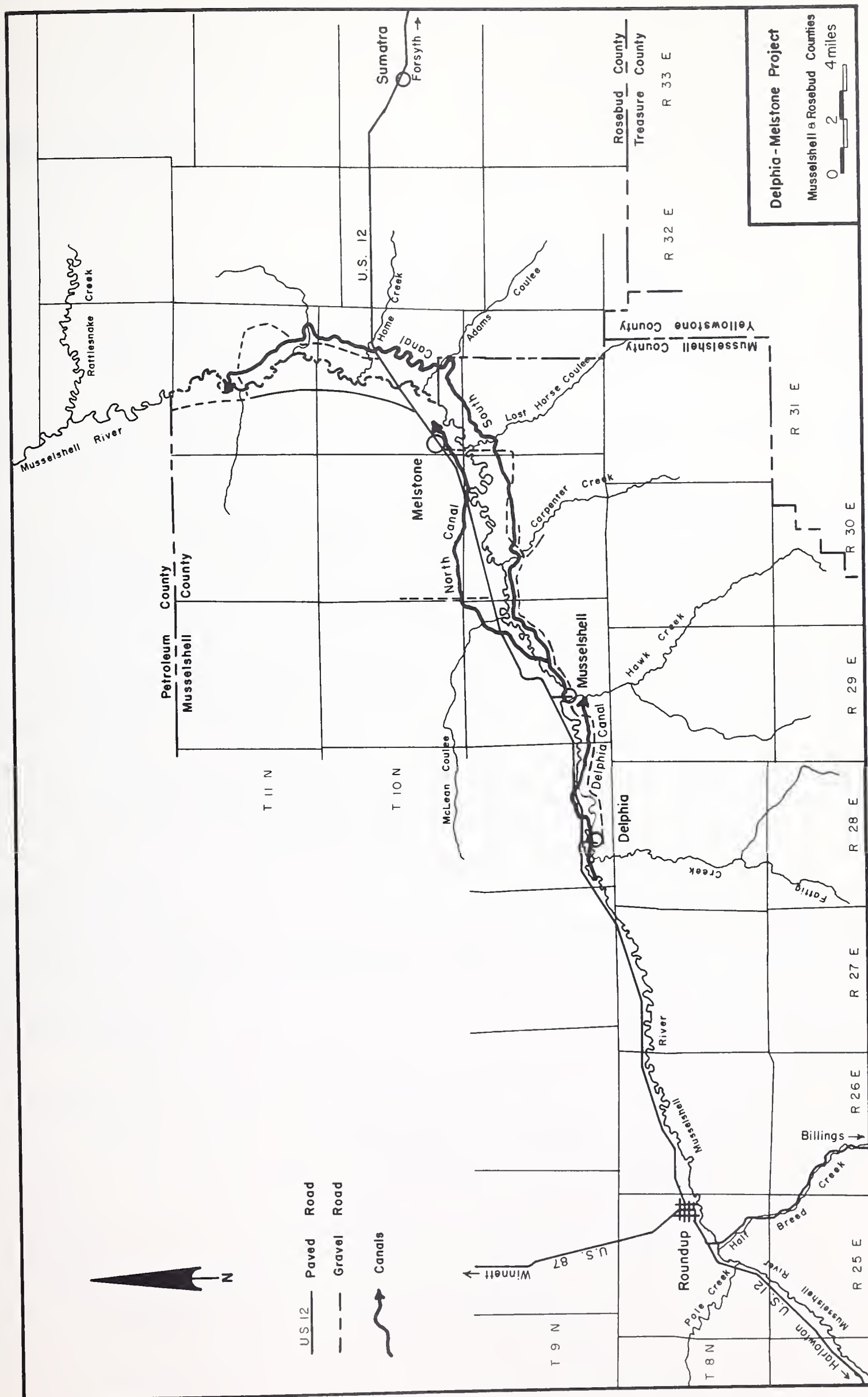
Diversion into the canals is measured by Department measuring stations. Water is divided among the water users at the turnouts by a ditchrider without the aid of measuring devices.

## Engineering Data

STORAGE:	Direct Diversion
CANALS:	
Delphia Canal	9.5 miles Capacity: 40 cfs 4 siphons under Musselshell River Concrete diversion and headgate



Melstone Diversion	1.5 miles Capacity: 220 cfs Concrete diversion and headgate 3 60" x 60" slide gates
North Canal	15.0 miles Capacity: 100 cfs Concrete diversion and wood plank headgate
South Canal	33.4 miles Capacity: 135 cfs Concrete diversion and wood plank headgate







# Flint Creek

The Flint Creek Project, located southwest of Philipsburg in Granite County, includes the East Fork of Rock Creek Dam and the Main, East, Marshall, Allendale, and Metcalf canals. The reservoir has a capacity of 16,040 acre-feet. The combined length of the canals is 46.6 miles. Construction, completed in 1938, was financed with a loan and grant from the PWA and with SWCB funds.

The Flint Creek Water Users Association has requested that an RC&D study, to evaluate the project and to recommend solutions to problems, be conducted on its project.

One of the major problems is a shortage of water, partly due to leaky canals, especially the Main Canal, which traverses steep mountainsides and experiences severe leakage and failures. Additional storage sites on side drainages are being considered. The Association has been lining some canals with bentonite to help stop the leakage.

Another problem is the jet pump in the outlet tunnel. The jet pump keeps the gate tower dry, protecting the metal pipes and machinery in the tower, but it is not working properly at the present time. Repairs may involve draining the reservoir.

The U.S. Forest Service (USFS) is interested in updating the Special Use Permit for the reservoir, which lies on National Forest Land. The original permit was written when the reservoir was built.

## Water Measurement

Because Flint Creek is adjudicated, the entire Flint Creek Basin is controlled by ditchriders and water commissioners.

## Engineering Data

DAM:	
Storage	16,040 acre-feet
Spillway	Width: 50'
	Capacity: 3,000 cfs
Gates	1 54" diameter slide gate and 1 54" diameter butterfly valve. Dry tower
Height	87'
Length	1,075
Type	Earthfill, 404,000 cu. yds.
Content Measuring Device	Cable down dam face

CANALS:

Main 7.7 miles  
Capacity: 200 cfs  
Concrete headgate and 4050' of 54" steel pipe siphon

East 5.81 miles  
Capacity: 63 cfs  
Concrete headgate

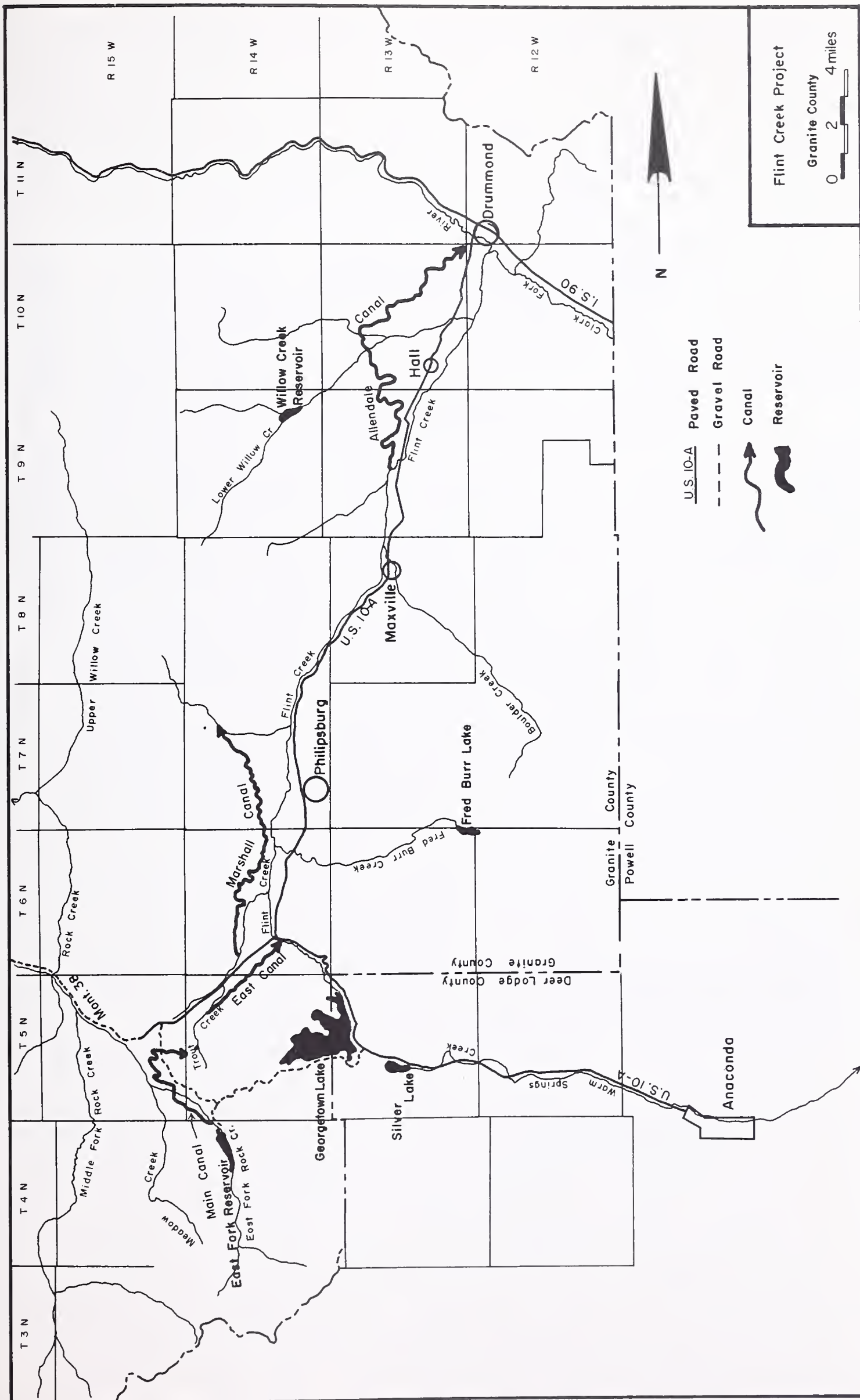
Marshall 16.02 miles  
Capacity: 56 cfs  
Concrete headgate and check

Allendale 12.96 miles  
Capacity: 125 cfs  
Concrete headgate and rock diversion

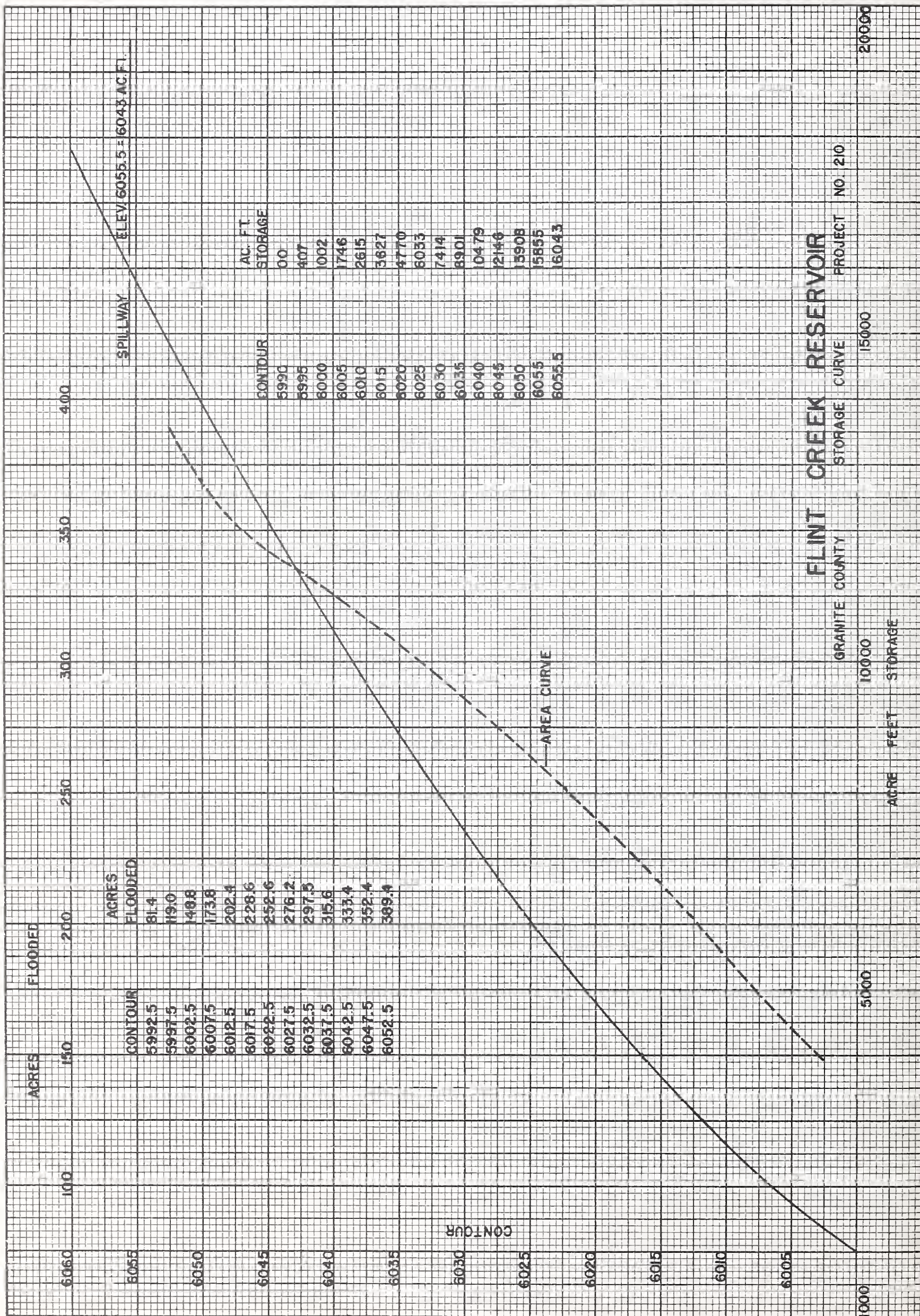
Metcalf 4.1 miles  
Capacity: 17 cfs

Measuring Devices: Water Stage Recorders on Main, Marshall, Allendale and Trout Creek.

R/W Reservoir Pool	420.00 acres deeded and USFS permit
Reservoir Land	489.11 acres deeded and USFS permit
Canals	
Main	82.3 acres deeded
East	30.07 acres partially deeded
Marshall	98.0 acres partially deeded
Allendale	No acreage listed
Metcalf	15.01 acres partially deeded









# Fred Burr

The Fred Burr Project consists of a storage reservoir on Fred Burr Creek eight miles west of Victor in Ravalli County. The reservoir has a storage capacity of 516 acre-feet, and an additional 300 acre-feet per year is available from streamflow. The project, located on Forest Service land, serves 920 acres. Construction, completed in 1948, was financed with SWCB funds along with loans totaling \$7,000 from local individuals.

During the 1974 dam safety inspection, the outlet tunnel was found to be in need of repairs at almost every joint of the concrete pipe. These joints were sealed by the Association in 1975 using an epoxy mix. Although the repairs were holding as of the 1975 inspection, there is some concern that the repairs may not last, since the surface could not be dried before the epoxy was applied. The seepage may be overcome only by draining the reservoir.

The US Forest Service is interested in updating the Special Use Permit written when the reservoir was built.

## Water Measurement

There is no water measurement on this project.

## Engineering Data

### DAM:

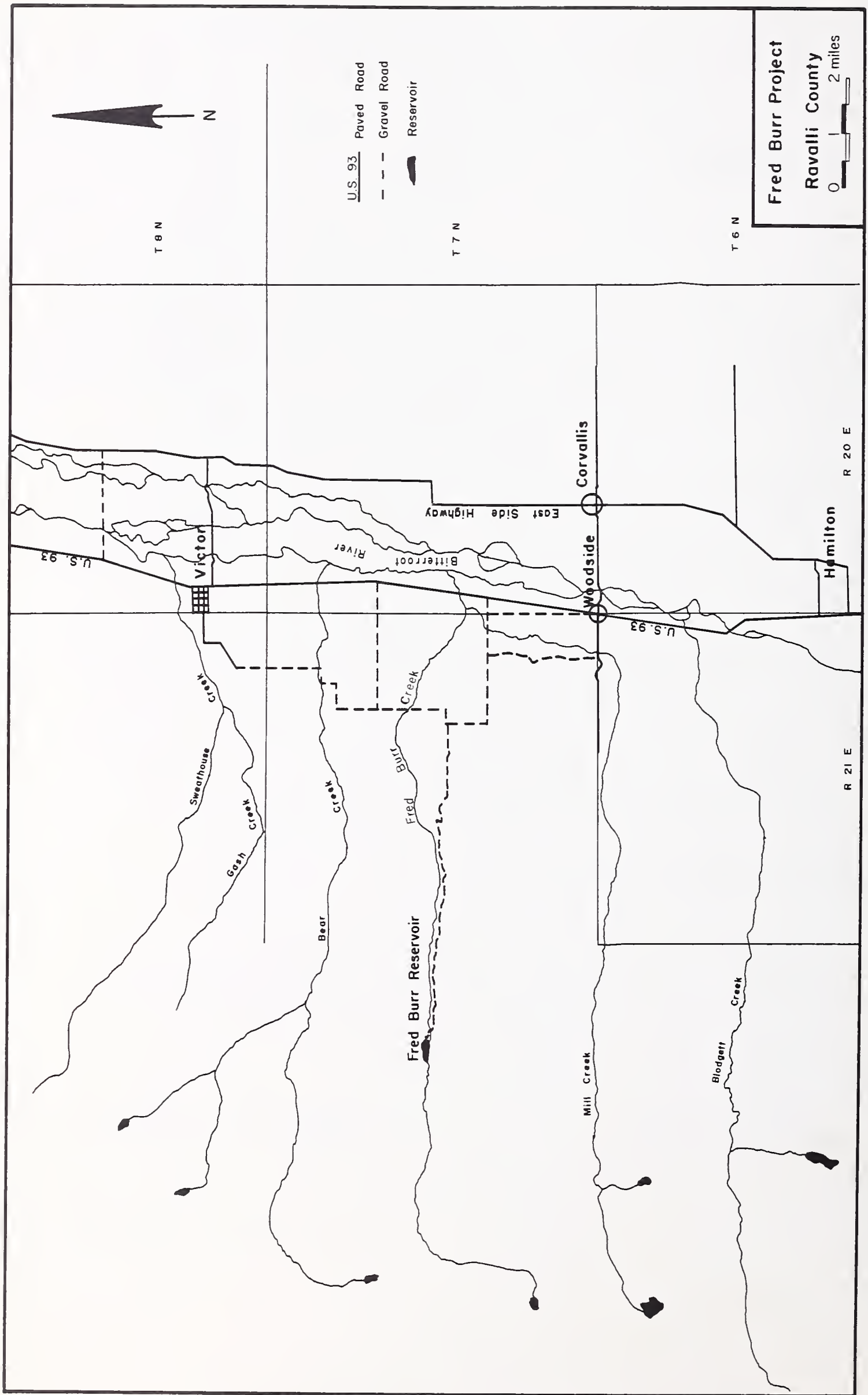
Storage	516 acre-feet
Spillway	Width: 18'
	Capacity: 1,400 cfs
Gates	1 48" diameter slide gate. Wet tower
Height	50'
Length	275'
Type	Earthfill, 10,600 cu. yds.
Measuring Device	Tape in tower

### CANALS:

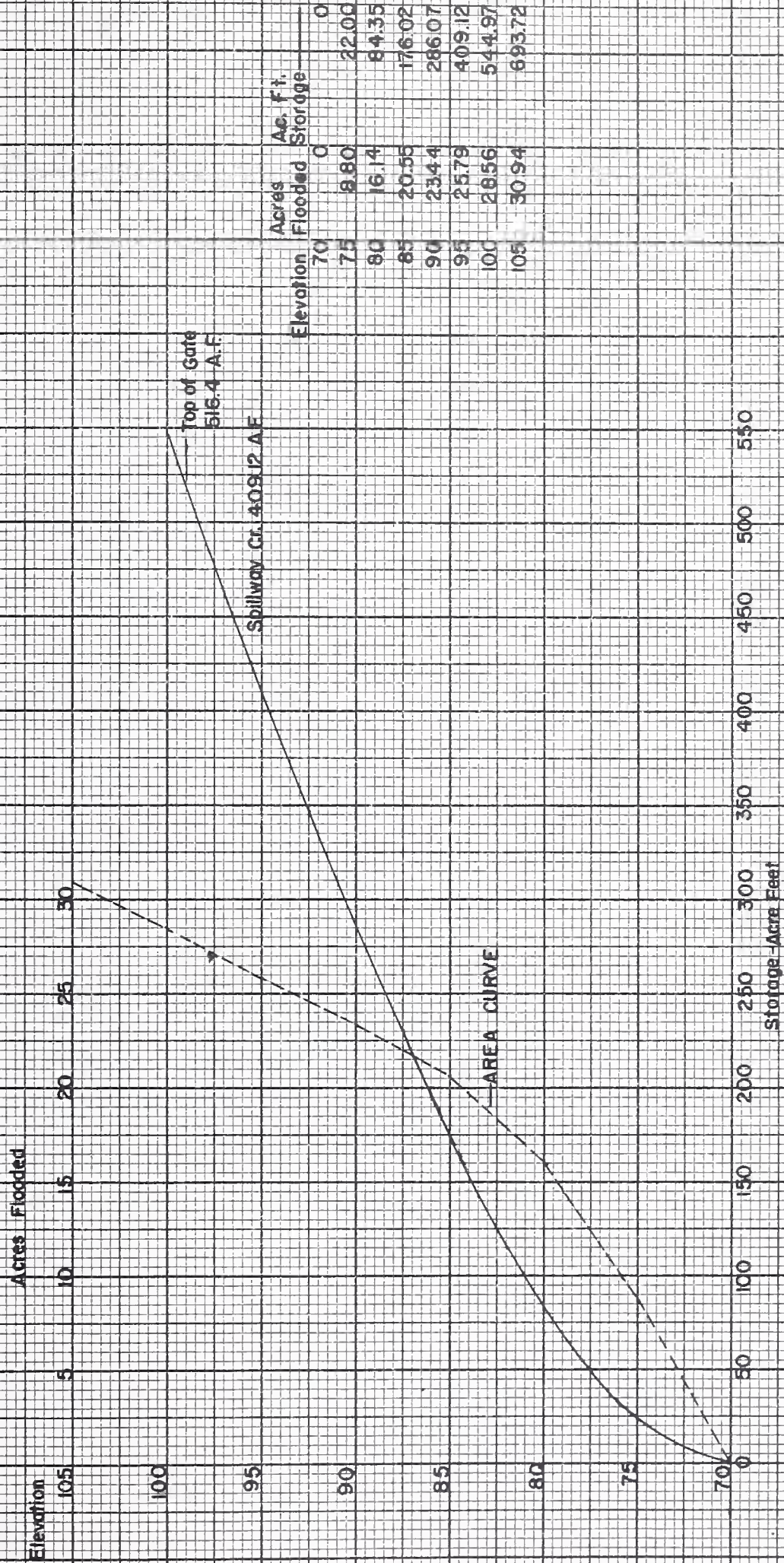
Private

### R/W

USFS Special Permit. Unsurveyed







Elevation	Acres Flooded	Ac. Ft. Storage
70	0	0
75	8.80	22.00
80	16.4	84.35
85	20.55	176.02
90	23.44	266.07
95	25.79	409.12
100	28.56	544.97
105	30.94	693.72

**FRED BURR RESERVOIR**  
 STORAGE CURVE  
 RAVALLI COUNTY PROJECT NO. 386





# Frenchman

This project, consisting of a dam and reservoir with a capacity of 7,010 acre-feet, is located about seventeen miles north of Saco in Phillips County. Canals and diversions on the project are privately owned. Construction of the project was financed from the SWCB's revolving fund (except for a federal grant of \$171,732.78 from the Flood Disaster Fund) and was completed in 1950. Much of the project water is transported through a private canal owned by the Frenchman Canal Company.

This project continues to be in good condition as a result of the Frenchman Water Users Association's excellent operation and maintenance program.

Cavitation of the outlet tunnel just below the operating gate, discovered during the 1972 annual inspection, was repaired by the Association soon after the inspection. A small amount of renewed cavitation found during the 1976 inspection was promptly repaired by the Association. Similar repairs will probably be required almost every year, as is the case on many other dams similar to Frenchman.

## Water Measurement

Since the water is delivered through a nonadjudicated stream to private diversions out of the river, no measuring devices are used; most water users have private water rights of an unknown quantity in addition to their contracts. Most of the water is delivered to the private Frenchman Canal Company, which handles the division of the water between contracts and private water rights.

## Engineering Data

### DAM:

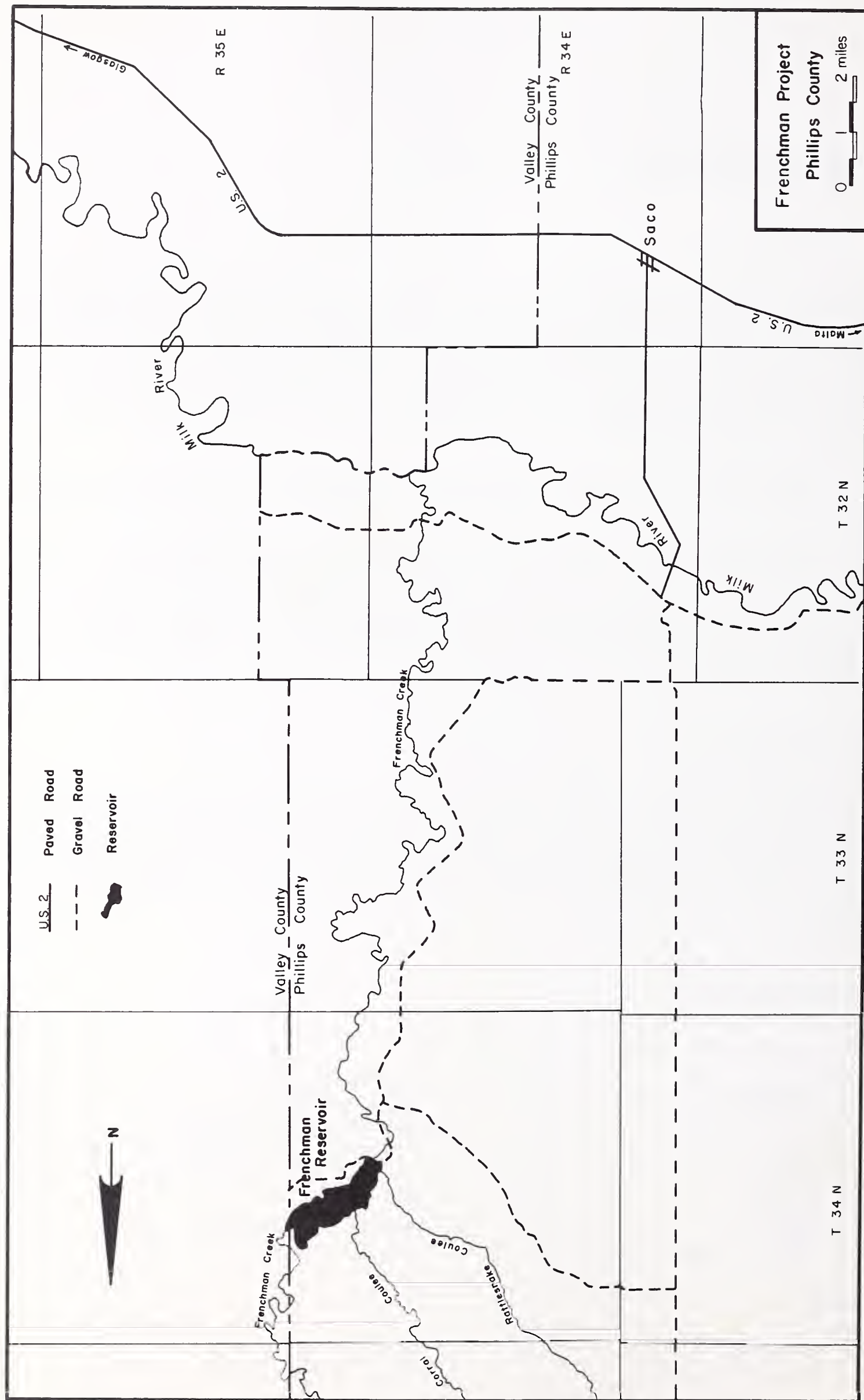
Storage	7,010 acre-feet
Spillway	Width: 125'
	Capacity: 12,000 cfs
Gates	2 60" x 60" slide gates. Wet Tower
Height	41'
Length	498'
Type	Earthfill, 83,000 cu. yds.
Content Measuring Device	Tape in tower

### CANALS:

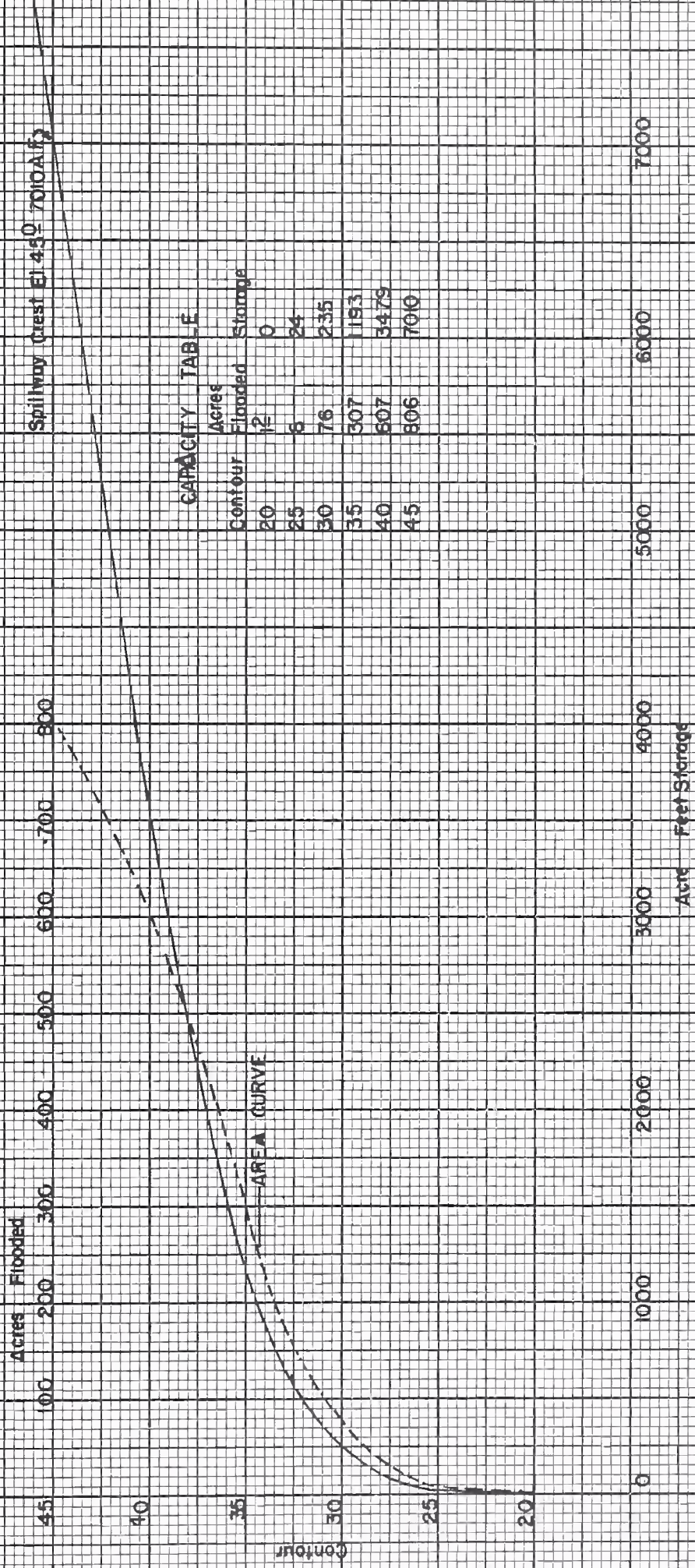
Private

R/W Reservoir Pool	806.0 acres deeded
Reservoir Land	447.64 acres deeded









CAPACITY TABLE

Contour	Acres Flooded	Storage
20	12	0
25	6	24
30	76	235
35	307	1193
40	607	3479
45	806	7010

FRENCHMAN RESERVOIR  
STORAGE CURVE

PHILLIPS COUNTY PROJECT NO. 714







# Green Mountain

The Green Mountain Project consists of a diversion canal from Swamp Creek (near Trout Creek) and eight miles of laterals which supply water for irrigation to land which has been cleared of timber in Sanders County.

Although the original construction, financed by the WPA and the SWCB, was completed in 1940, the project has never been completely finished and has never functioned properly. The project was inspected in 1975, and area water users were interviewed to determine local interest in purchasing water. It was found that interest had increased considerably in recent years, but rejuvenation of the project will be hampered by a serious leakage problem in the canals and by a shortage of water since there is no means for storage in Swamp Creek. In the fall of 1974, the Green Mountain Water Users Association replaced a deteriorated wooden diversion headgate structure with a concrete structure, but some alterations may be needed to ensure that it lasts.

## Water Measurement

There are no measuring devices on this project.



# Hotchkiss

The Hotchkiss Project is a diversion dam and canal on the Tongue River near Brandenburg in Rosebud County. The Department has had little involvement with this project. In 1965 it was operating and in fairly good condition.





# Hysham

The main features of this project near Hysham in Treasure County are a pump to lift water from the Yellowstone River, two relift pumps, a canal system, and related structures. The project, financed with SWCB funds, was completed in 1950. In 1973, the Burlington Northern, Inc., built the Sarpy Creek spur line through the project area, and as a result some improvements were made to the canal at Burlington Northern's expense.

In 1969 the Department allowed the Hysham Water Users Association a moratorium on the payment of principal to allow them time to become more financially stable. However, there has been some dispute over the intended length of the moratorium. In addition, a sizable portion of the state's original investment has never been secured by contracts because less water was marketed than originally intended. To rectify these problems, the Department is renegotiating the water marketing contract with the Association to ensure that the entire state debt will be repaid.

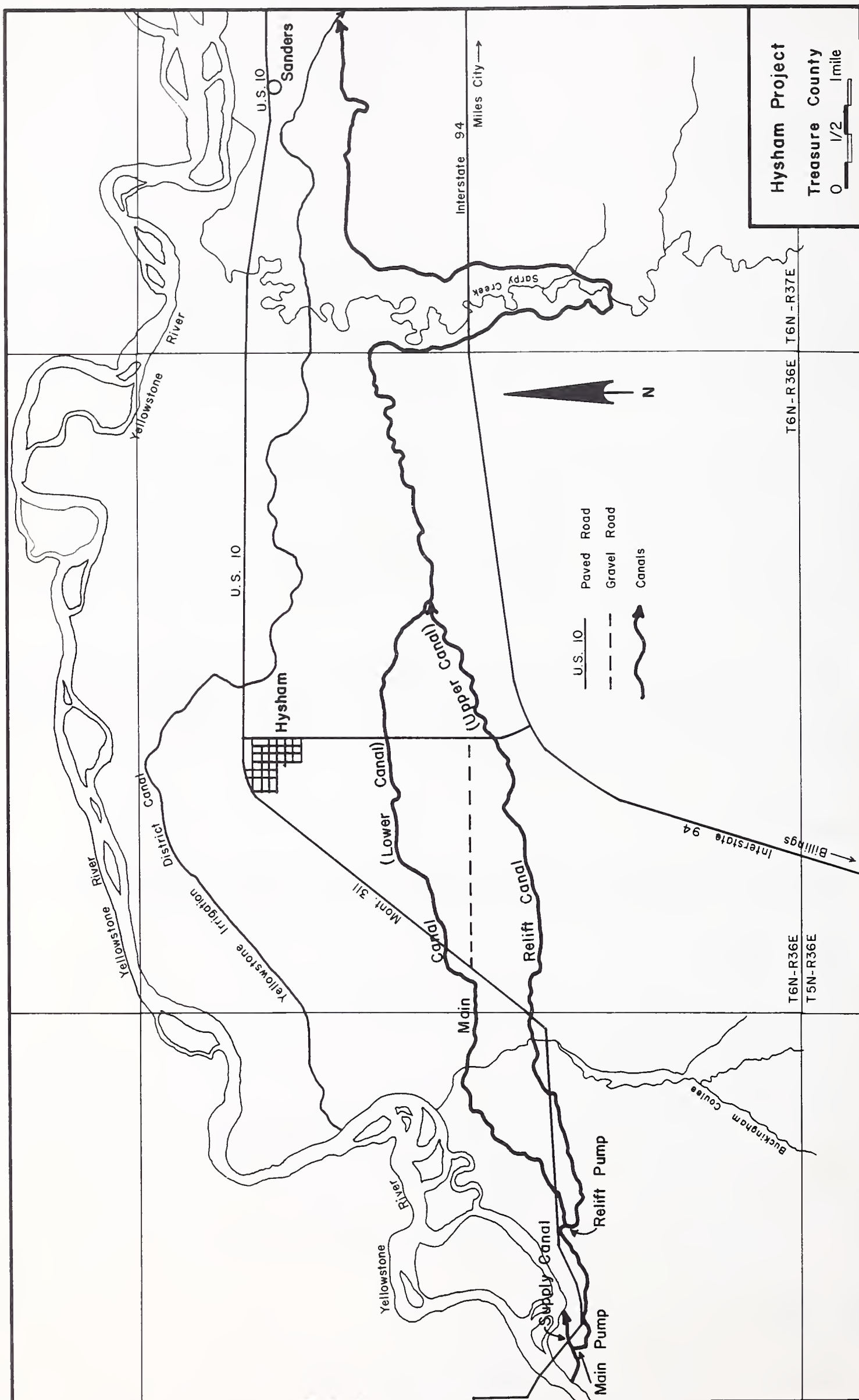
The Association may be faced with many expensive repairs to the project in the future. The Department inspected the project in 1975 and found that possible repairs include overhauling or replacing the six pump units and their electrical control systems and houses, lining several miles of canal with concrete, and installing a project-wide drainage system.

## Water Measurement

All water is measured through Penvane boxes or other measuring devices. Water in the canals is measured by two Department gaging stations.

## Engineering Data

STORAGE:	Direct diversion
CANALS:	
Main	19.3 miles Capacity: 133 cfs 3 350 HP pumps @ 19,500 gpm Lift: 56.02'
Relift	8.34 miles Capacity: 47 cfs 3 100 HP pumps @ 6,750 gpm Lift: 45.11
POWER LINES:	12.36 miles
R/W Main	128.67+ acres deeded
Relift	40.43+ acres deeded





# Lewistown Ditch

The Lewistown Ditch Project includes a rock diversion and a wood and concrete headgate on Big Spring Creek in the city of Lewistown. Several miles of canal deliver water to land along the south side of Big Spring Creek northwest of Lewistown. The project is actively operated and maintained by the Lewistown Ditch Water Users Association. Although involvement of the Department is limited, the Department recently designed a trashrack for the pipe under Highway #191 and resumed regular attendance of the Association's annual meetings in order to determine what the future involvement of the Department should be.

## Water Measurement

Water is diverted and divided among the water users without the aid of measuring devices.



# Lisk Creek

The Lisk Creek Project, completed in 1937, is a 700-acre-foot storage project on Lisk Creek, an intermittent stream in McCone County.

No successful irrigation has been carried on from this project because the earthen spillway of the dam washed out several times. A field investigation in 1969 found the dam and spillway in fair condition. At that time, the Montana Department of Fish and Game (DFG) was stocking the reservoir with trout each year, and fishing was enjoyed by local residents.

The spillway was again seriously damaged in 1971 and 1972, causing little property damage except that the county road crossing the spillway was washed out. McCone County rebuilt the road across the spillway, adding more fill and a culvert. Neither the DFG nor McCone County is interested in acquiring ownership of the project. A private landowner has indicated a slight interest.





# Little Dry

The Little Dry Project (also known as the Wasson Flats Project), located in Garfield County about thirty miles southeast of Jordan, now consists of a reinforced concrete diversion and a twelve-mile canal. Originally developed in the 1930's by the SWCB and the WPA, it was completed in 1937 or 1938. The project operated for several years; however, the earth diversion dam failed several times, and the ditch was finally abandoned in the early 1940's.

Complete rehabilitation of this project was accomplished during the fall of 1972, including reconstruction of the diversion from Little Dry Creek, rebuilding the canal system, and adding and rebuilding turnouts and siphons. Of the \$144,000 required for this project, \$52,000 was provided by a grant under the Rural Environmental Assistance Program (REAP) of the Agricultural Stabilization and Conservation Service (ASCS). The Department and the Little Dry Water Users Association signed a new water marketing contract which will pay back the state's investment.

The project functions by diverting flood flows, which may come at any time of the year, from Little Dry Creek. Hoping to eventually stabilize these flows and to expand the project, the water users have asked the SCS to prepare a preliminary design for a storage reservoir on Little Dry Creek. Early indications are that the cost will be extremely high; however, many other interested ranchers may be willing to share the cost. The local groups have applied to the Department for a water-right permit.

## Water Measurement

Flows in the canal are measured by a nonrecording measuring device. There is a measuring device at each turnout.

## Engineering Data

### DIVERSION:

Dam material	Concrete
Height	14.4 feet, 4-foot flashboards
Length	124 feet

### CANAL:

Earth
11.6 miles
90 cfs





# Livingston Ditch

This project in Park County consists of a diversion dam in the Yellowstone River and a canal ten miles long with a capacity of eighty cfs. Construction was completed in 1937. The project was financed with a federal loan and grant and with SWCB funds.

The diversion dam and headgate were damaged by a landslide when the construction of a new highway caused an unstable hillside to slip. The Montana Department of Highways has agreed to pay for the replacement of the structure. A new diversion structure has been designed by the Department of Natural Resources and Conservation. The headgate structure will be replaced during the fall of 1977 to ensure full water delivery, although replacement of the dam and wingwalls will be delayed until the slide becomes stable. Highway Department geologists estimate the slide is still moving at a rate of one-quarter inch per year. To ensure that funds are set aside for the future replacement of the dam, the Highway Department is currently negotiating a written agreement with the Livingston Ditch Water Users Association.

The Association is actively engaged in improving the canal system, which runs through the city of Livingston.

## Water Measurement

Water in the canal is measured by a Department gaging station. The Association has a program to install several measuring devices each year, and hopes to eventually have a measuring device at each turnout.

## Engineering Data

### DAM:

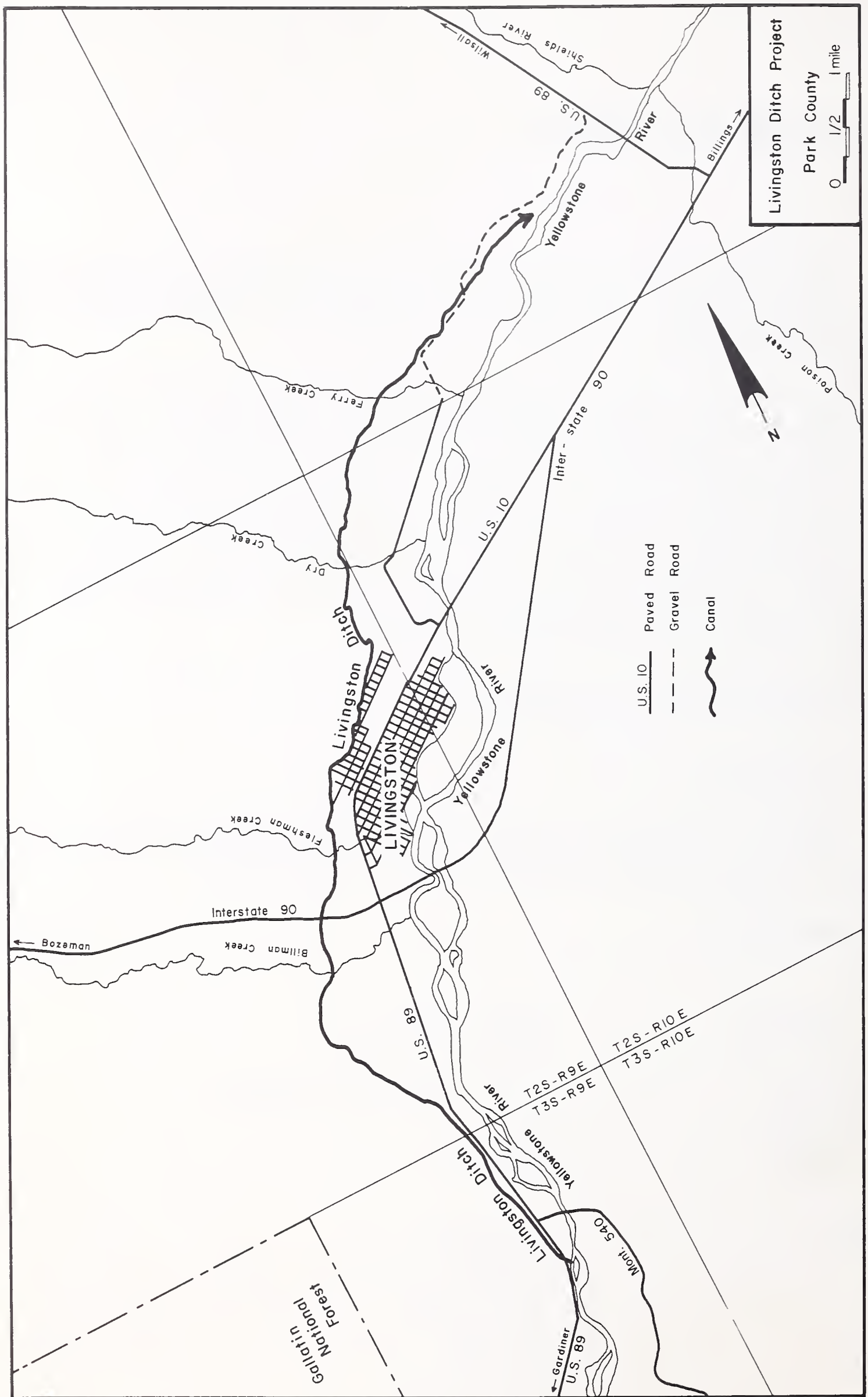
Storage	Direct diversion
Spillway	Width: 140'
	Capacity: unknown
Gates	2 42" x 60" slide headgates
Height	4.5
Length	140'
Type	Concrete

### CANAL:

10.2 miles  
Capacity: 80 cfs  
1,287 feet of timber lining  
887.1 feet of corrugated metal pipe lining

### R/W

No deeds -- took over Park Irrigation Company



# Middle Creek

The Middle Creek Project consists of Middle Creek Reservoir (commonly known as Hyalite Reservoir), located fifteen miles south of Bozeman on Middle (Hyalite) Creek in Gallatin County, and Cottonwood Canal, which has a length of 4.11 miles and a capacity of seventy-seven cfs. The reservoir has a storage capacity of 8,027 acre-feet. Construction of the project, started in 1939, was not completed until 1951. Financing was accomplished through a loan and grant from the federal government and SWCB funds. The project supplies municipal water for the city of Bozeman and Montana State University and supplemental water for sixteen thousand acres of irrigated land in the Gallatin Valley. Hyalite Reservoir receives heavy recreational use.

Damages to the outlet tunnel, discovered during the 1973 dam safety inspection, necessitated installation of a new stem deflector and gears for the operating and emergency gates during the spring of 1974. Newly installed safety equipment in the gate tower will make operation and inspection of the gates much safer. The emergency spillway is in a deteriorated condition, and estimates indicate that repair costs will be excessive; to avoid further damage, the reservoir is currently operated according to an SCS operating plan (using runoff forecasts to maximize irrigation storage, flood control, recreation, and other benefits) which minimizes the use of the spillway. In 1974, the Department installed two stream-gaging stations, one on the East Fork and one on West Fork of Hyalite Creek above the reservoir. These stations should aid in the operation of the reservoir.

The US Forest Service is interested in updating the Special Use Permit for the reservoir, which lies on National Forest land. The original permit was written when the reservoir was built.

## Water Measurement

Inflow to the reservoir is measured by two Department gaging stations. Monthly water surface elevations are recorded by the Department. Outflows are measured by a USGS gage. Storage water is delivered to Middle Creek, where it is diverted by state and private diversions without measuring devices.

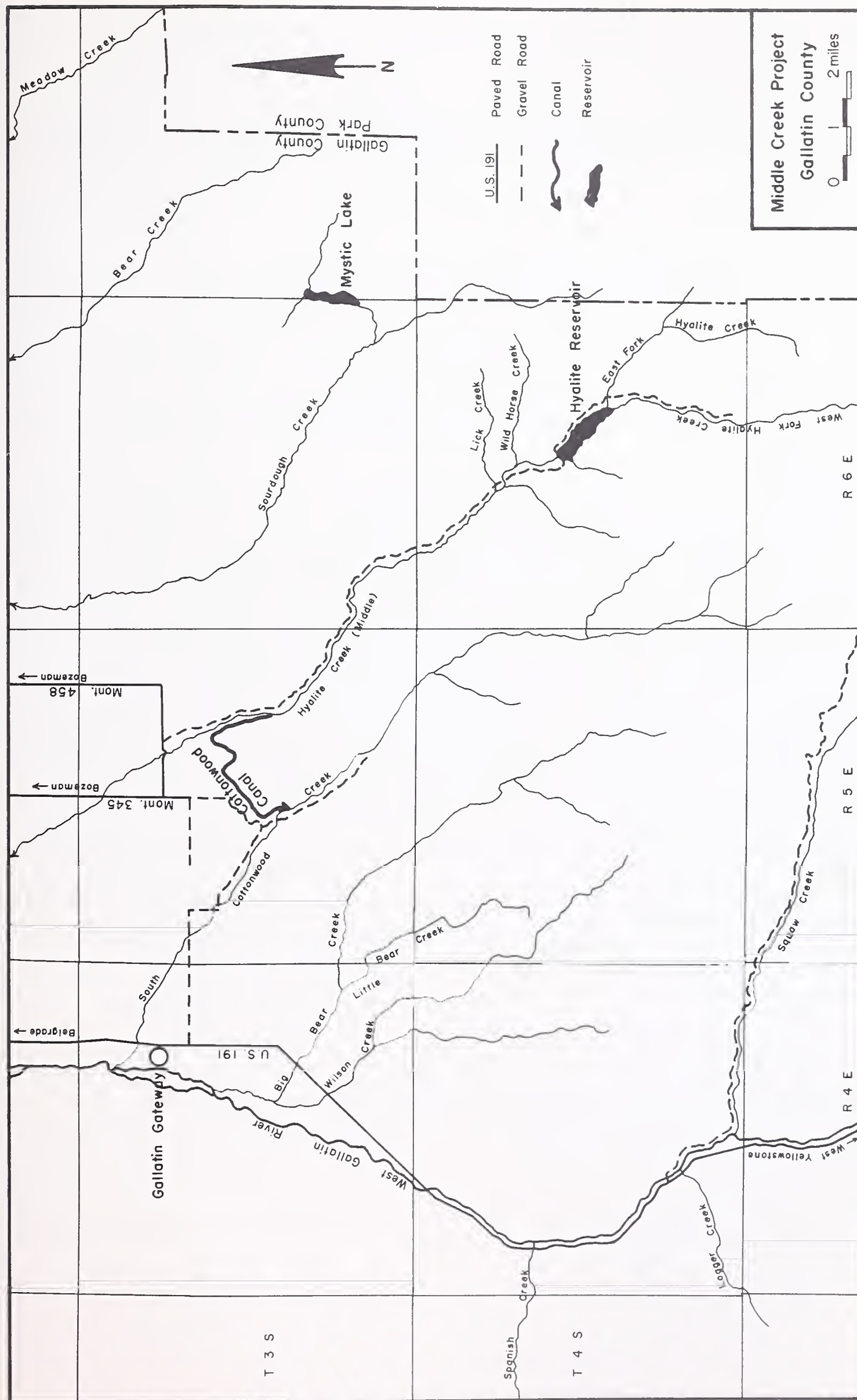
## Engineering Data

DAM:

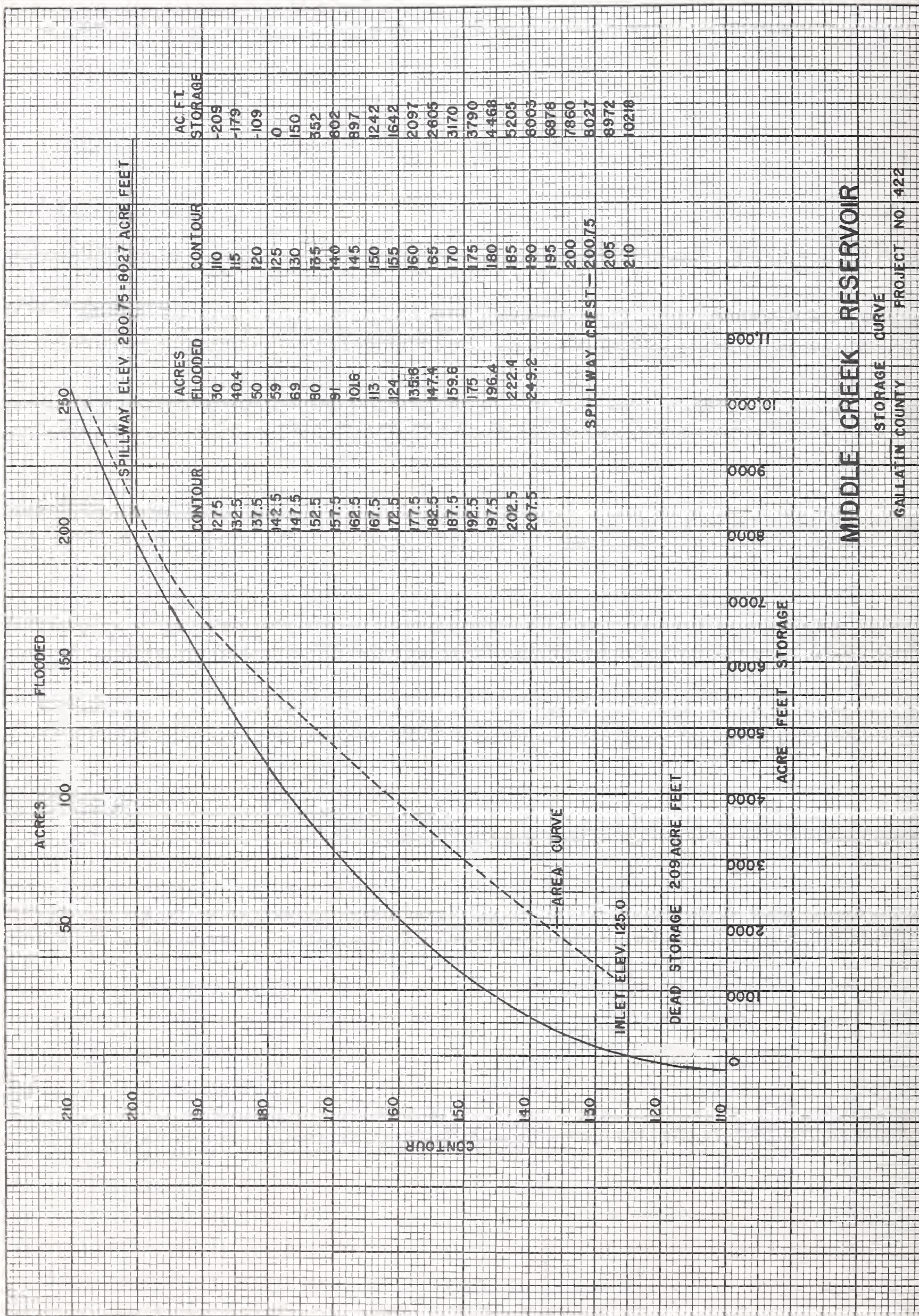
Storage	8,027 acre-feet
Spillway	Width: 40'
	Capacity: 3,000 cfs



Gates	1 54" diameter slide gate and 1 54" diameter butterfly valve. Dry tower.
Height	110'
Length	1,310'
Type	Earthfill, 569,500 cu. yds.
Measuring Device	Inside pressure tube
COTTONWOOD CANAL:	
	4.11 miles
	Capacity: 77 cfs
	1,054' of metal flume
R/W Reservoir Pool	212 acres deeded and USFS permit
Reservoir Land	54.22 acres deeded and USFS permit
Canal	60.38 acres deeded and USFS permit









# Nevada Creek/Nevada North Canal

The Nevada Creek Project in Powell County consists of a reservoir on Nevada Creek and a canal distribution system which includes the Nevada North Canal Project. Some of the users utilize the two canals in the system, and others divert water directly out of Nevada Creek or its tributaries. Several users upstream from the reservoir use prior-right water in exchange for reservoir water, which is delivered to users below the reservoir who have the prior rights. The project was financed with a loan and grant from the PWA and with SWCB funds. Construction was completed in 1940.

Recent maintenance at Nevada Creek, found necessary during the 1972 dam safety inspection, included the removal and repair of a fifty-four-inch, butterfly-valve operating gate in the outlet tunnel of the dam. The emergency gate was covered with a protective epoxy coating. These repairs in the spring of 1974 cost the Association about \$24,000.

The floor of the spillway has deteriorated, and investigations by the SCS have shown that building a reinforced concrete spillway within the existing structure would be the best repair alternative. A preliminary estimate (1975) set the cost at \$189,000. The Association applied for an RRD grant to help offset the high cost of the structure; the application is before the 45th legislature. Some federal funding may also be obtained by the Association. Meanwhile, the Association is operating the reservoir to avoid the use of the spillway.

The Nevada North Canal has a leakage problem which severely limits water sale from the reservoir.

An RC&D study begun by the SCS and completed in April 1975 identified problems (including erosion, leaky canals, and deterioration on the spillway and other structures) with the project and recommended possible solutions to these problems.

## Water Measurement

The Department maintains gaging stations on the river below the dam and on the Douglas Canal and keeps monthly records of water surface elevations. Deliveries are made by a water commissioner with the aid of measuring devices on most turnouts.

## Engineering Data

DAM:

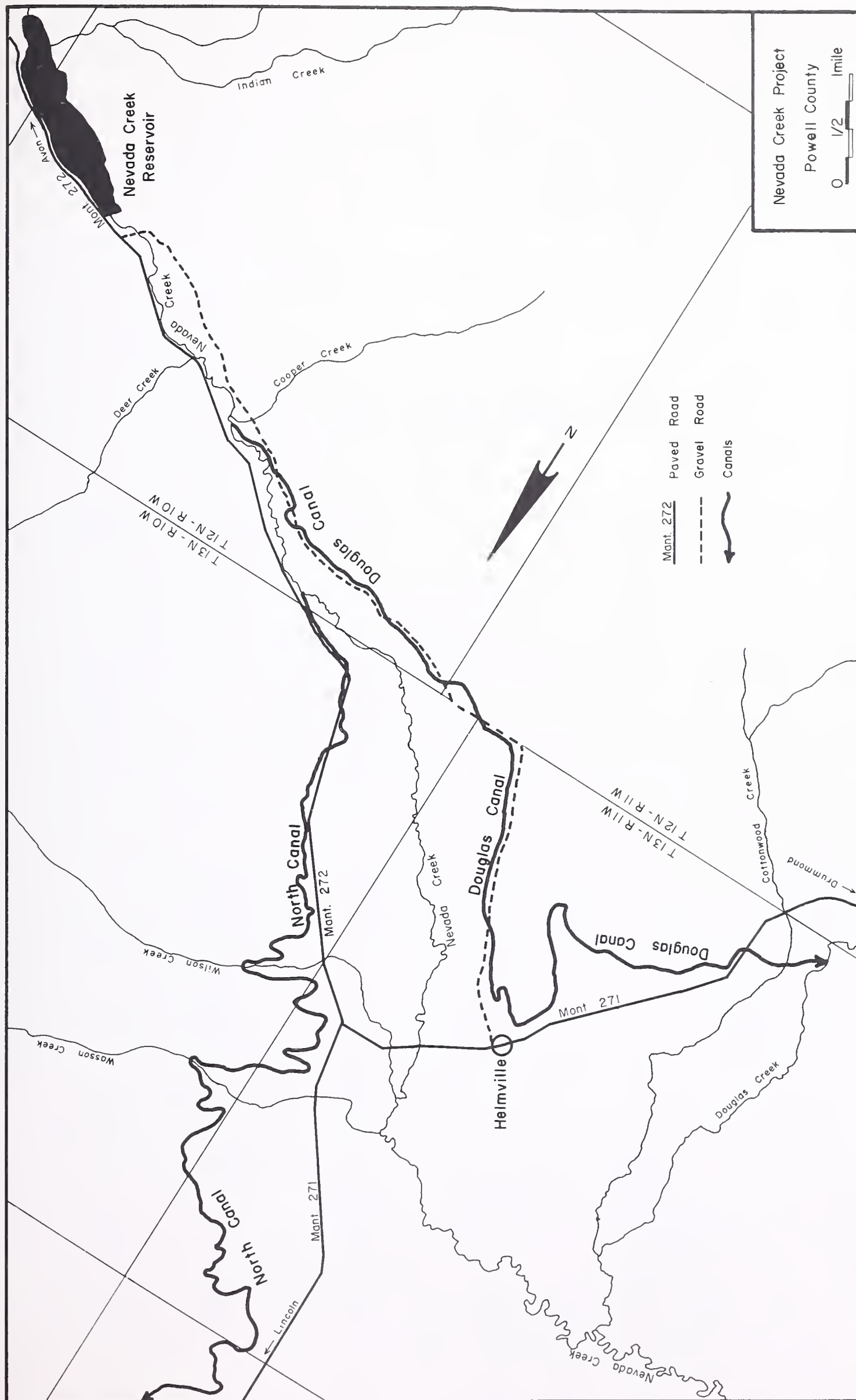
Storage	12,640 acre-feet
Spillway	Width: 100'
	Capacity: 9,000 cfs

Gates	1 54" diameter slide gate and 1 54" diameter butterfly valve. Dry tower.
Height	83'
Length	1,195'
Type	Earthfill, 386,500 cu. yds.
Content Measuring Device	Cable down face

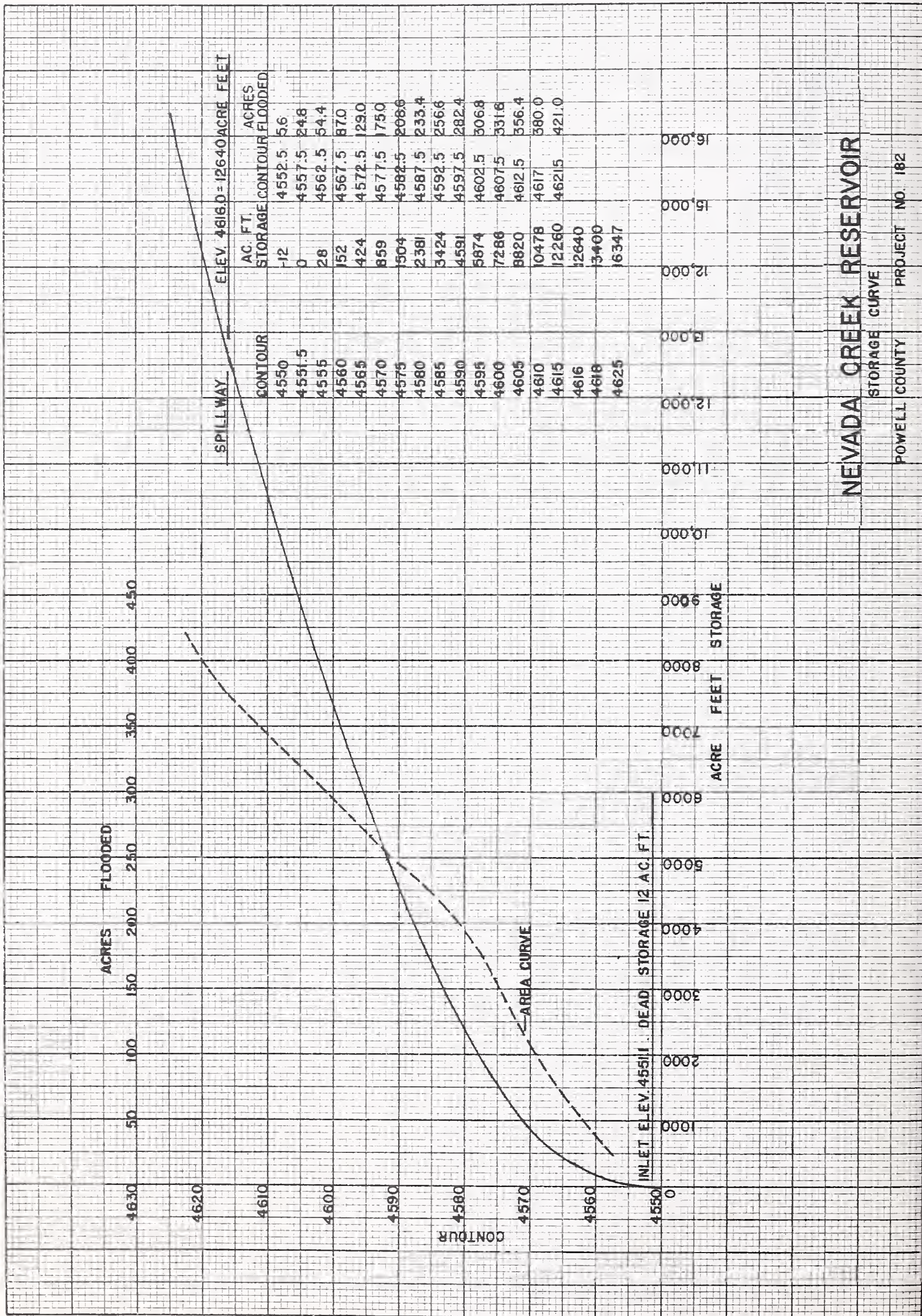
CANAL:

Douglas	12.6 miles
	Capacity: 50 cfs
North	13.4 miles
	Capacity: 49 cfs

R/W	Reservoir Pool	375 acres deeded
	Reservoir Land	183.54 acres deeded
	Douglas Canal	73.19 acres partially deeded
	North Canal	No deeds









# Nilan/Florence Canal

These projects are located near Augusta in Lewis and Clark County. The Nilan Project supplies water to the Florence Canal and other water users. Because of their close relationship, Nilan Reservoir and Florence Canal are often named together as Nilan-Florence, and both are operated by the Nilan Water Users Association. Nilan Reservoir, with a capacity of 10,092 acre-feet, was completed in 1951, and the Florence Canal was completed in 1955. Substantial work was necessary on the Florence Canal soon after it was constructed in order to make it operable.

No more water is available for sale from Nilan. Because of heavy water sales during the last few years, the state will realize full recovery of its investment in the project.

An erosion problem exists at the end of the Florence Canal because no structure was built to handle the excess water. However, the Montana Department of State Lands is working with the local ranchers to develop land at the end of the canal. Included in their plan is a structure to safely discharge excess water without erosion.

Seepage drains have been installed on the north dam at Nilan. Riprap is still needed on the face of the dam to prevent further wave erosion.

## Water Measurement

Records of monthly water surface elevations and five gaging stations are maintained by the Department. Many deliveries cannot be accurately controlled because contract water is mixed in the river with private water rights of unknown quantity.

## Engineering Data

DAM:

Storage	10,092 acre-feet
Gates	East Dam: 1 48" x 48" and 1 48" diameter slide gate. Wet tower. North Dam: 1 48" x 48" and 1 48" diameter slide gate. Wet tower.
Height	East Dam: 44' North Dam: 34'
Length	East Dam: 1,010' North Dam: 530'
Type	Earthfill, 125,000 cu. yds. total

Content Measuring Device      Tape in east tower

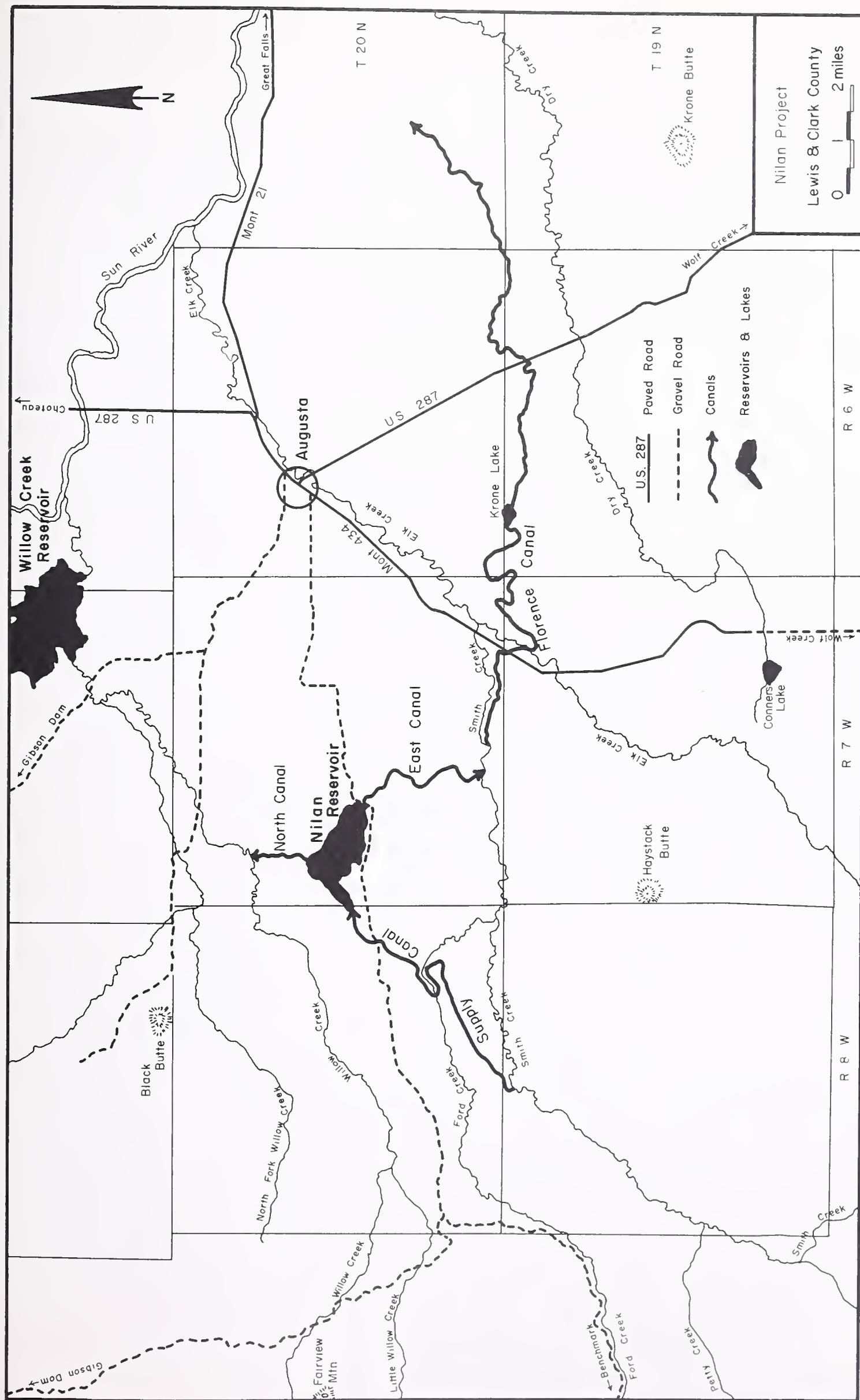
CANALS:

Supply	5.47 miles
	Capacity: 300 cfs
East	5.2 miles
	Capacity: 74 cfs
North	2.05 miles
	Capacity: 75 cfs
Florence	16.25 miles
	Capacity: 85 cfs

Measuring Devices      Water stage recorders on all canals.

R/W Reservoir Pool	535 acres deeded
Reservoir Land	207.26 acres deeded
Supply Canal	25.09+ acres partially deeded
Outlet Canal	15.6+ acres partially deeded
Florence Canal	269.11 acres partially deeded







Acre Flooded

4450 100 200 300 400 500 600 700

4445

4440

4435

4430

4425

4420

4415

4410

4405

Contour

— AREA CURVE

— Spillway Crest 425 Storage 10,092 Ac. Ft.

Contour	Acre Flooded	Ac. Ft. Storage
4402	63	0
4405	71	194
4410	100	621
4415	141	1,220
4420	200	2,067
4425	260	3,243
4430	337	4,702
4435	399	6,542
4440	494	8,792
4445	554	11,391
4450	666	14,436

Acre Feet Storage

Dead Storage 900 A.F. Above El. 4382.7

NILAN RESERVOIR

STORAGE CURVE

LEWIS & CLARK COUNTY PROJECT NO. 73



# North Fork of Smith River

This project, also called the Smith River Project, consists of a dam and storage reservoir about nine miles northeast of White Sulphur Springs in Meagher County. The reservoir has a capacity of 11,600 acre-feet and a surface area of 325 acres when full. Construction of the dam, financed with a loan and grant from the PWA and with SWCB funds, was completed in 1936. Recreational use of the reservoir includes camping, boating, and picnicking.

Most of the water used is taken through private diversions from the river. The South Side Canal, another Department project, obtains most of its water supply from Smith River Reservoir storage.

A solution to the deterioration of the spillway floor is being sought. The use of an epoxy sealer after proper surface preparation may be attempted by the North Fork of Smith River Water Users Association next summer (1977). The concrete base to the operating gate control unit is cracked. The Department is now trying to determine an effective method of repair.

## Water Measurement

The inflow to the reservoir is measured by the two Department gaging stations. Monthly water surface elevations are recorded by the Department. Diversions from the river are controlled by a water commissioner.

## Engineering Data

### DAM:

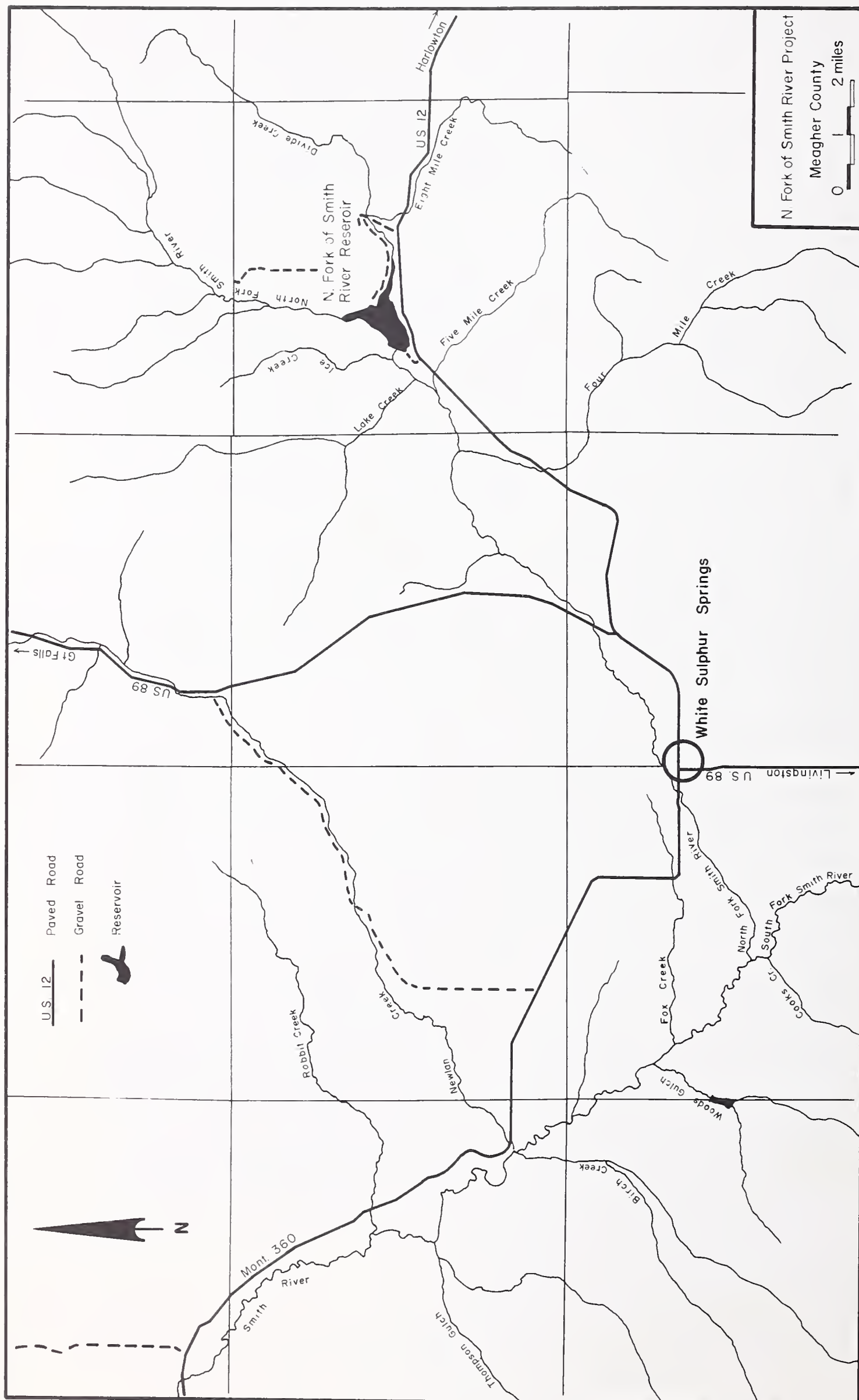
Storage	11,600 acre-feet
Spillway	Width: 80'
	Capacity: 4,000 cfs
Gates	1 54" diameter slide gate and 1 54" butterfly valve. Dry tower.
Height	86'
Length	1,223'
Type	Earthfill, 391,000 cu. yds.
Content Measuring Device	Elevation pins down face

### CANALS:

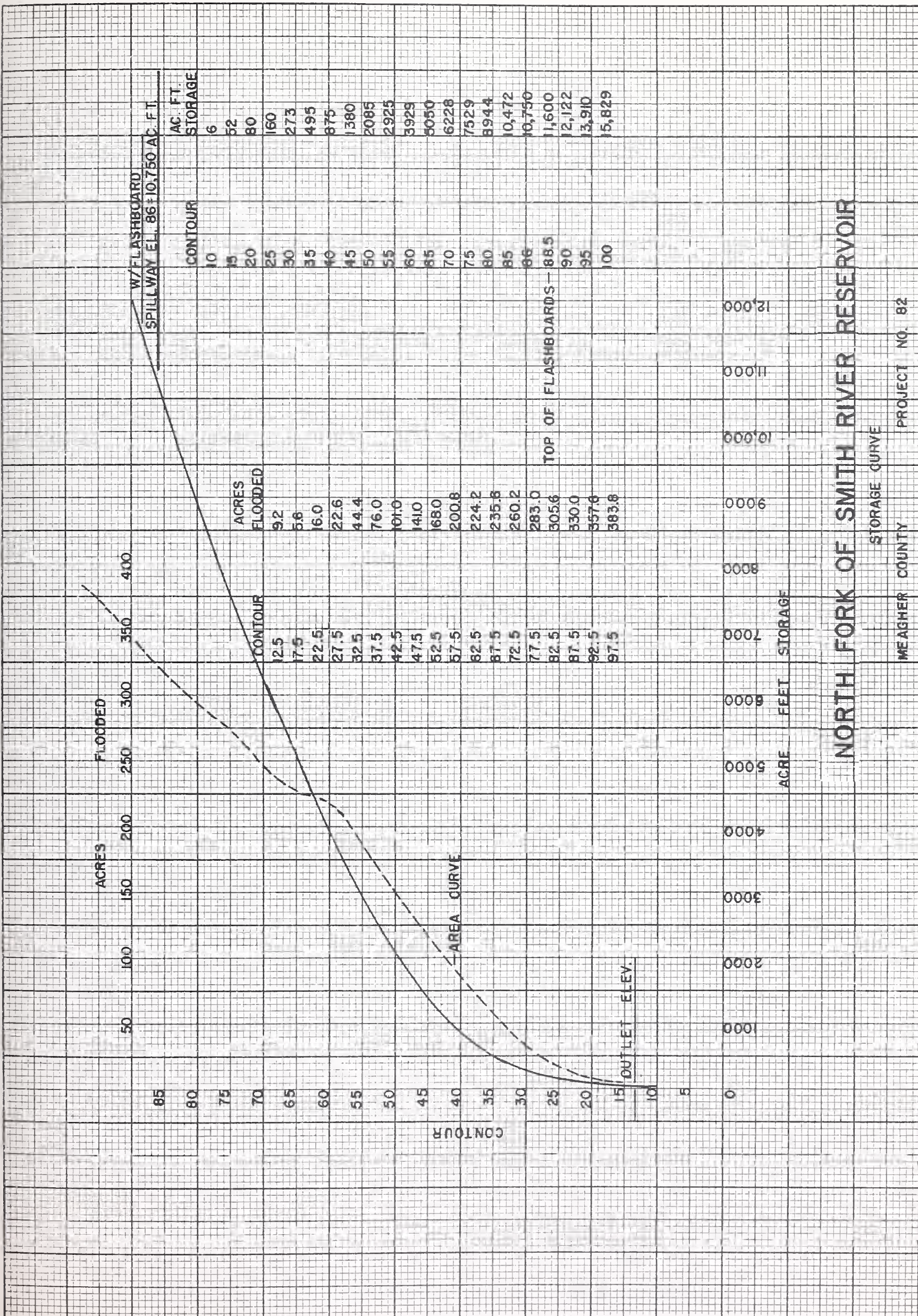
None

R/W	Reservoir Pool	335 acres deeded and easement
	Reservoir Land	189.95 acres deeded and easement









# NORTH FORK OF SMITH RIVER RESERVOIR

STORAGE CURVE

MEAGHER COUNTY

PROJECT NO. 82







# North Winifred

The North Winifred Project, completed in 1938, is on Homestake Creek near the town of Winifred in Fergus County. It consists of Stafford Dam, a 335-acre-foot storage reservoir, and canals which have been essentially unused.

Although local interest expressed at the time of the application for the project was sufficient to indicate that project water would be used for irrigation, the project has received little use for that purpose. In recent years, the reservoir has become a popular boating and fishing area for local residents.

Since the project is in need of repairs, the Department has considered turning the project over to local interests or to the DFG to be further developed for recreational purposes. The Department has contacted the DFG several times in recent years, but as yet no agreement has been reached.

During the spring of 1975, sufficient runoff occurred to force water over the earthen spillway, causing some damage. The dam was closely watched by Department personnel during high water so that downstream residents and land-owners could be warned if the structure threatened to fail. The resultant damage was not serious, however.



# Painted Rocks

This project, also known as the West Fork of Bitterroot Project, consists of a dam and reservoir located on the West Fork of the Bitterroot River about thirty miles south of Darby in Ravalli County. Storage capacity of the project is 32,362 acre-feet. Financed with a federal grant and loan and state general funds, construction was completed in 1939.

There is no active water users association on this project, which is operated and maintained by the Department's field headquarters at Hamilton. Water from the reservoir is sold to one landowner (on temporary contract) and to the DFG. The DFG buys 5,000 acre-feet of water per year and pays an O&M charge of \$500.00 per year. Its water purchase contract, now paid in full, amounted to \$110,400.00.

An inspection in April 1972 indicated that extensive repairs to the gates and tunnel were needed. These repairs were finished in April of 1974 at a cost of approximately \$60,000.

The 1974 inspection indicated that the repairs were satisfactory, but in 1975 it was found that extensive cavitation had destroyed the repairs and had removed the steel plates and all the concrete from one area of the floor of the tunnel, exposing native granite. It was determined that deficiencies in the original tunnel design prevented the safe release of the high flows necessary if the structure is used for flood-control benefits, as has been the practice during recent years.

Harza Engineering Corporation of Chicago was hired to investigate the cause of the damages and to design repairs. The new design included a large vent shaft to supply air to cushion the water and prevent cavitation.

Meanwhile, an environmental impact statement (EIS), Proposed Repairs to Painted Rocks Dam, was prepared by the Department and published in October 1976. The report indicated that downstream flows would be cut off during construction. Later, the Department agreed to provide downstream flows of 15 to 30 cfs to maintain the fish populations by means of a 12-inch-diameter pipe through the outlet tunnel, as was done during the 1974 repairs. It was determined that draining the reservoir was unavoidable.

## Water Measurement

The USGS maintains gaging stations on the river just below the dam and at Darby. There are no permanent water users besides the DFG, so measurement is not necessary.

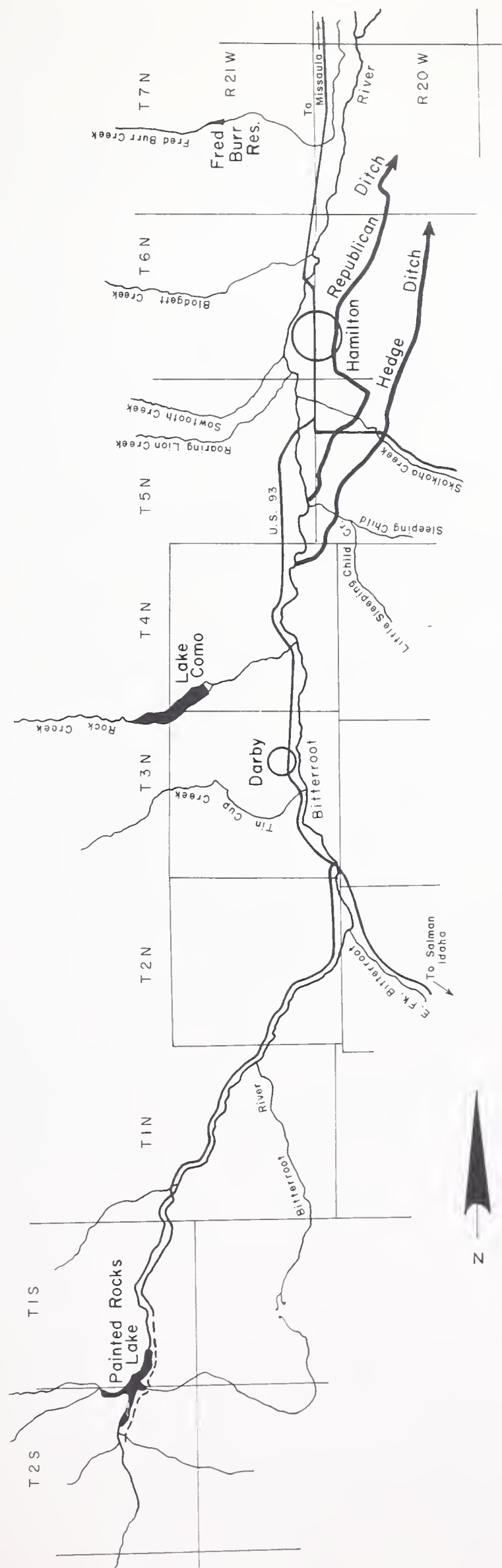


## Engineering Data

### DAM:

Storage	32,362 acre-feet
Spillway	Width: 160'
	Capacity: 26,000 cfs
Gates	2 5' x 8' slide gates. Wet tower.
Height	143'
Length	800'
Type	Earthfill, 853,000 cu. yds.
Measuring Device	Tape in tower

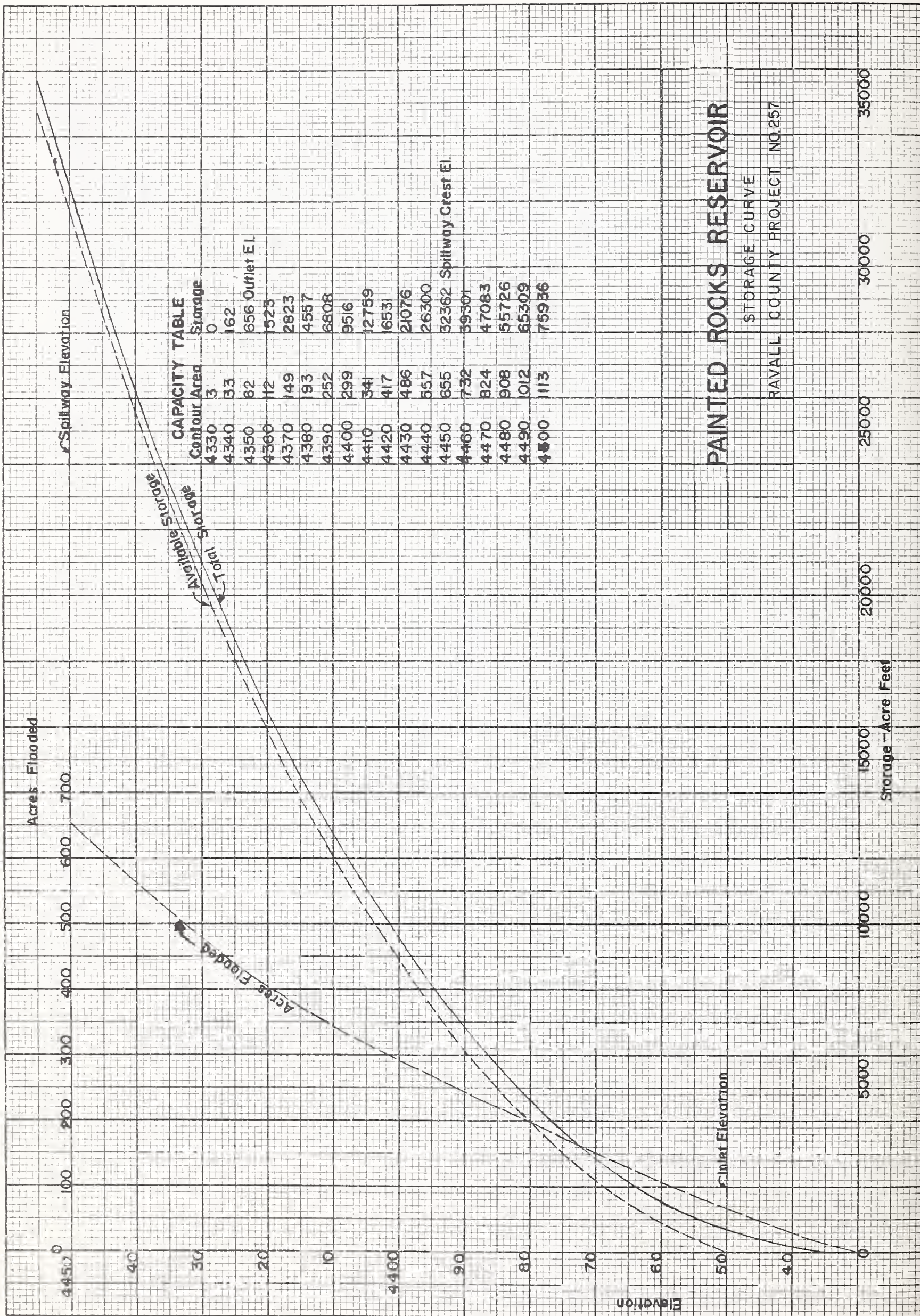
R/W	Reservoir Pool	655 acres deeded and USFS permit
	Reservoir Land	383.33 acres deeded and USFS permit



- Paved Road
- - - Gravel Road
- ~ Canals
- ▶ Reservoirs

Painted Rocks Project  
 Ravalli County  
 0 2 4 miles







# Park Branch/Paradise Canal

These two projects are considered together because of their close physical relationship.

Park Branch, operated by the Park Branch Water Users Association, is a direct diversion project taking water from the Yellowstone River approximately three miles above Emigrant in Park County. The canal, located on the west side of the river, is 20.9 miles long and has an initial capacity of 350 cfs. Construction of the project, financed by a loan and grant agreement from the PWA and by SWCB funds, was completed in 1937.

Paradise Canal, operated by the Paradise Canal Users Association, is located on the east side of the Yellowstone River. Water is siphoned under the Yellowstone River through a 506-foot-long, 48" concrete siphon from the Park Branch Canal. The canal, 11.2 miles long and with a capacity of eighty-five cfs was completed in 1957.

These projects experience water supply problems because the multichannelled Yellowstone River is apparently slowly shifting its flow away from the channel containing the diversion dam. The Park Branch Canal washed out in several places during the flood in the spring of 1974, necessitating major repairs.

Water distribution is a problem on the Paradise Canal because the capacity of the canal decreases rapidly. Little new land can be developed unless it lies along the upper section of the canal.

## Water Measurement

Water in the Park Branch and Paradise canals is measured by a Department gaging station. Water is divided among the water users by a ditchrider. Most turnouts have measuring devices, and the associations have a program of adding new devices whenever possible.

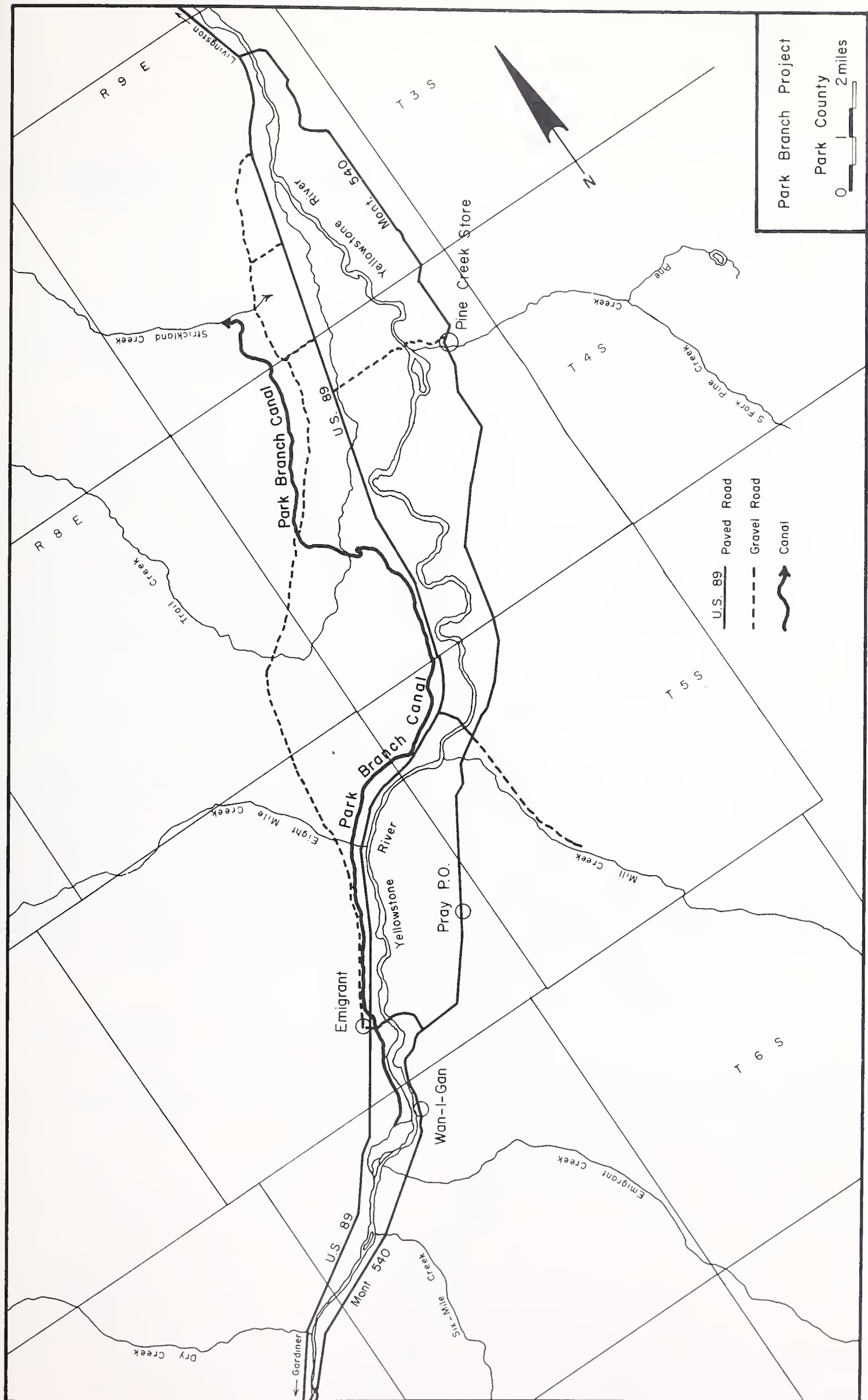
## Engineering Data

### DAM:

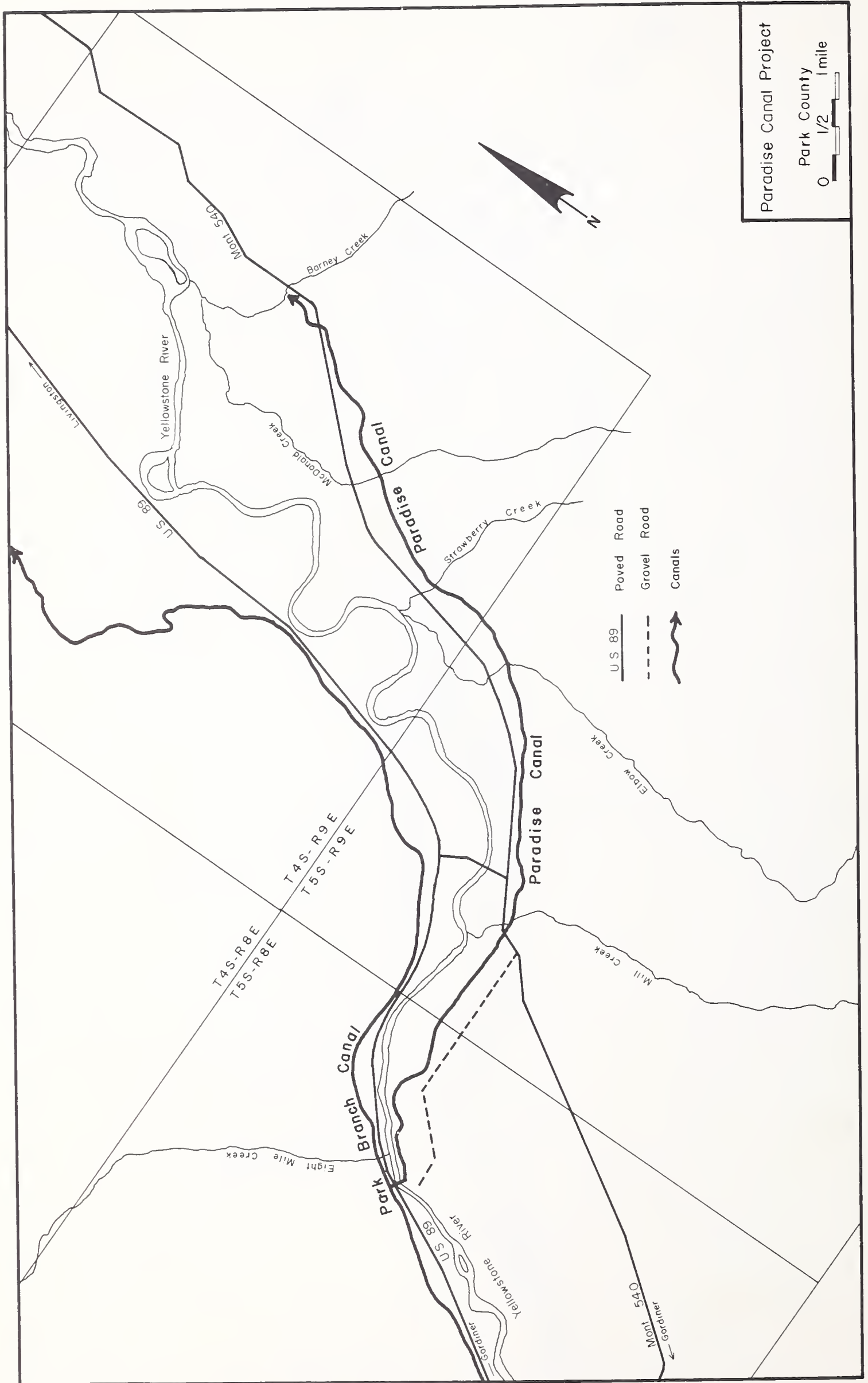
Storage	Direct diversion
Spillway	Width: 88'
Gates	4 42" x 60" slide headgates
Height	5'
Length	87'
Type	Concrete diversion weir with timber stop planks

CANALS:

Park Branch	20.9 miles
	Capacity: 350 cfs
Paradise	11.2 miles
	Capacity: 85 cfs
	506 ' of 48" concrete pipe siphon
R/W Park Branch	190.93 acres deeded
Paradise	104.33+ acres partially deeded







# Petrolia

The Petrolia Project, consisting of a storage dam, a main canal, a re-lift canal, a drop to Flatwillow Creek, and a short pump line, is located on Flatwillow Creek nine miles southeast of Winnett in Petroleum County. Construction was financed with SWCB funds and was completed in 1951.

The entire distribution system was inspected in 1972 and the condition and life expectancy of each structure determined. An analysis of the main seepage problem at the dam was completed by an SCS geologist in 1975. He determined that the seepage does not threaten the safety of the dam at the present time, but suggested several methods to monitor the seepage for future increases. He also suggested a few measures to protect the dam and its appurtenant structures from possible damage by the seepage. Several of his suggestions have already been implemented, and the Association plans to finish several more as funds permit. For example, the Association plans to install a pipe drain system at the left abutment of the dam to discharge seepage safely away from a concrete structure on the outlet canal. Some patchwork has been completed on the spillway floor, although further work is needed to prevent continued spalling of the concrete.

In 1976, the Department lined with concrete about 10,000 feet of ditch at a cost of \$99,925.65. Because a considerable amount of water had been lost in this section of ditch, spoiling some land, the new lining was an asset to the project. Funds for the repair were received from the ASCS and the FHA. The FHA loan was made to the Department, which in turn loaned it to the Petrolia Water Users Association. The sum was added to the remainder of the state's investment, which will be repaid in full under the new water marketing contract signed in December of 1976. New water purchase contracts are currently being signed by the water users.

## Water Measurement

Water is diverted and divided among the water users by a ditchrider. The Association recently adopted a plan to add several measuring devices to turnouts each year.

## Engineering Data

DAM:

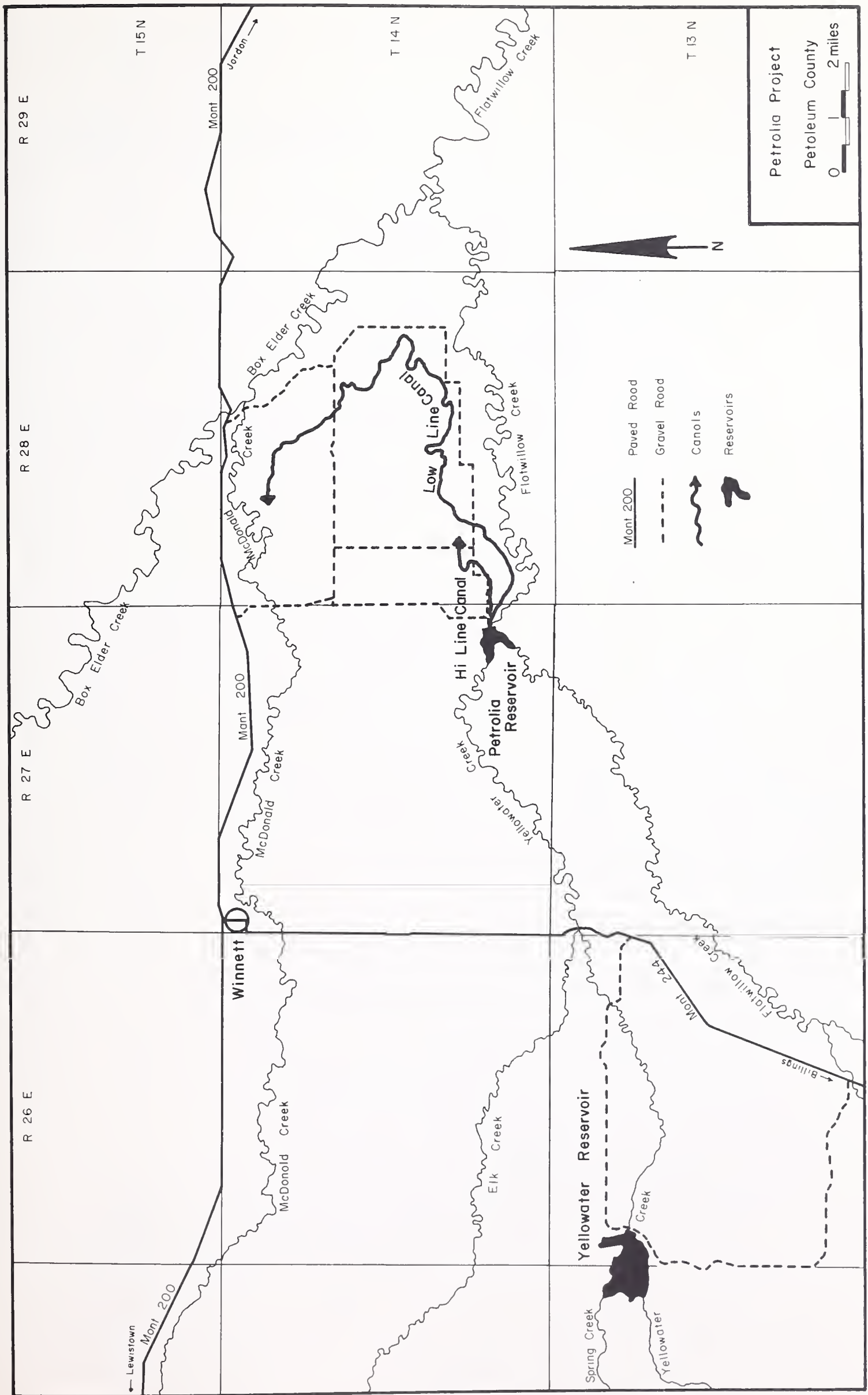
Storage	9,102 acre-feet
Spillway	Width: 100'
	Capacity: 7,000 cfs

Gates	1 60" x 60" slide gate and 1 60" diameter slide gate; 1 30" diameter slide gate on relift canal. 1 60" diameter slide gate on drop to creek.
Pumpline	Wet tower.
Height	60' of 16" metal pipe
Length	55'
Type	966'
Content Measuring Device	Earthfill, 300,000 cu. yds.
	Tape in tower

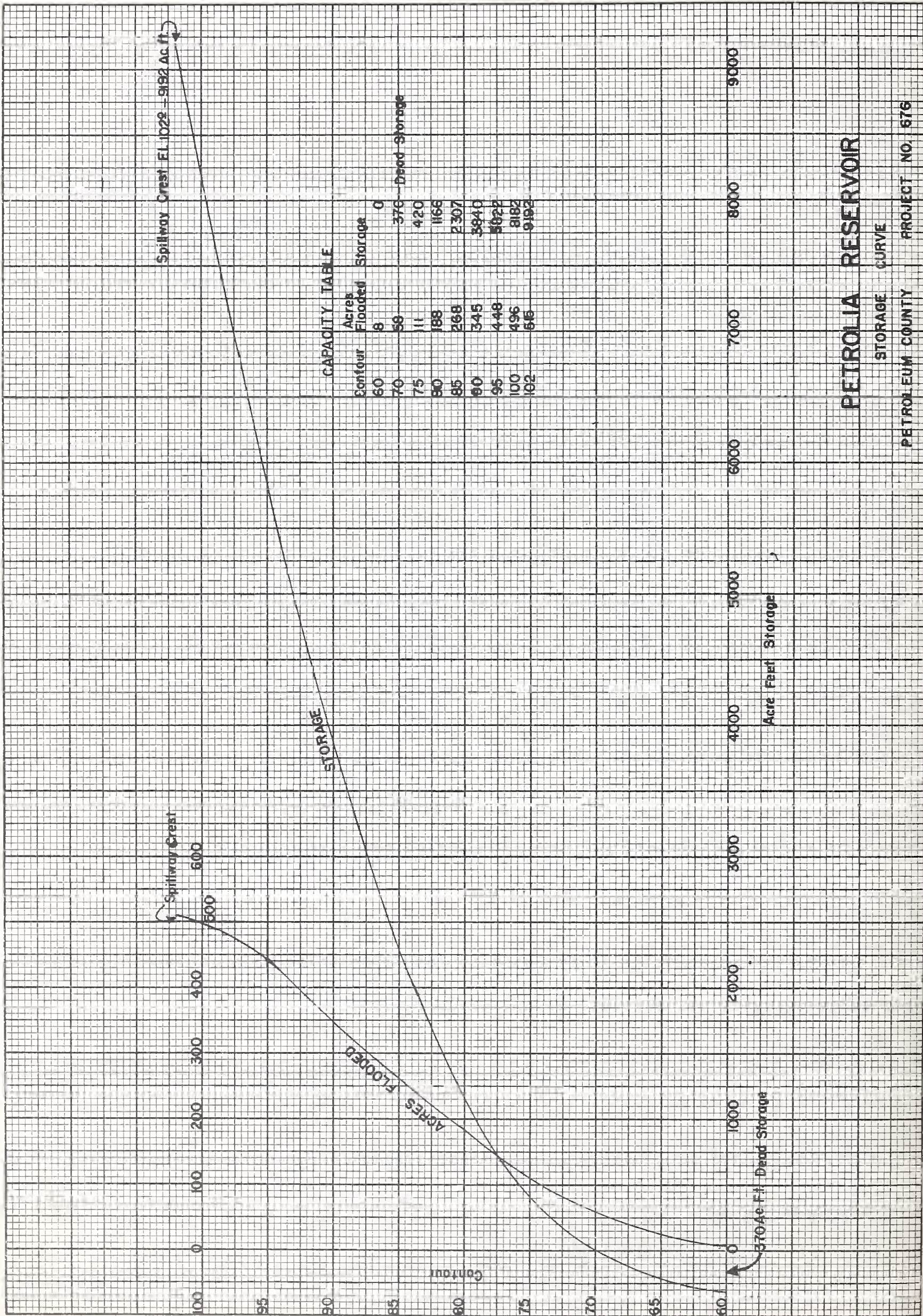
CANAL:

Main	12.67 miles
Relift	1.33 miles
R/W Reservoir Pool	515 acres deeded
Reservoir Land	226.91 acres deeded
Main Canal	112.72 acres deeded
Re-lift Canal	10.78 acres deeded











# Red Butte Creek

This project consisted of a small dam and reservoir near Baker in Fallon County. It received little use, so a terminal report was prepared which recommends that the Department release its right of way easements for the project.

Due to the unstable condition of the dam, the Department breached the structure during the summer of 1974. In this procedure, a section of the dam is removed to allow all flows of the stream to pass downstream. It will no longer be a safety threat.





# Rock Creek

This project, which consists of two storage reservoirs (Cooney Reservoir and Glacier Lake) and some canals, is located in Carbon County. Financed with a loan and grant from the PWA and with SWCB funds, the project was completed in 1937. Cooney Reservoir receives heavy recreational use, and the Montana DFG maintains the recreational facilities, which include boat docks, several picnic and camping areas, and access roads.

The original design of the dam, which has been lost, may have included a spillway which would control the water from the time it entered the spillway until it reached the creek. Due to a shortage of funds, alternative designs were investigated. An alternative location was found where underlying bedrock might prevent serious erosion if part of the spillway were not made of concrete. The spillway finally built consisted of one large concrete drop and a bedrock channel into a coulee which led to the main creek. The bedrock failed to protect the channel, however, and serious erosion occurred the first time the spillway was used. The SWCB then added several drop structures in the spillway channel to prevent the erosion from becoming worse. These structures are less than adequate and require repairs after each use. They are now in poor condition.

The Department has been working with the Rock Creek Water Users Association for the past few years to investigate alternatives for repair or replacement of the spillway. The Association has been reluctant to consider a complete redesign and replacement of the spillway because of the high anticipated cost. However, serious damage occurred during the 1975 runoff, and the Association was forced to make emergency repairs to the last drop structure. In light of the serious condition of the spillway and the possibility of failure, the Department informed the Association in 1976 that a complete redesign of the structure must be made. An independent panel of professional consulting engineers who inspected the spillway in November 1976 confirmed that the spillway must be redesigned and replaced as soon as possible. The Association and the Department are currently investigating possible sources of funding for the design and the new spillway. A bill submitted to the 45th legislature requesting 1.9 million dollars for this project was killed by the legislature.

Until the spillway is replaced, the dam will continue to be operated according to guidelines presented in an operation plan developed by the SCS which incorporates snow survey information and weather forecasts to anticipate runoff and allow the Association to adjust releases to maximize flood storage and irrigation benefits, resulting in minimal use of the spillway.

Several major repairs have recently been completed by the Association as a result of annual dam safety inspections. Damages to the outlet tunnel were repaired during the fall of 1975, financed with a loan from the Department of approximately \$10,000. Repairs made to the tunnel were to replace the top deflector of the operating gate, restore the ceiling and floor of the outlet tunnel, and repair the jet pump valve. In March 1975, an agency impact determination was written because the flow on Red Lodge Creek was to be stopped during the repairs. The report determined that the stoppage of the flow would cause no significant environmental degradation. However, the Association was able to supply downstream flows by means of an irrigation lateral from another drainage.

### Water Measurement

There are two USGS gaging stations above Cooney Reservoir and one below. There is a nonrecording measuring device below Glacier Lake. Monthly water surface elevations are recorded by the Department. Most water deliveries are controlled by a water commissioner with the aid of measuring devices. Red Lodge Creek from Cooney Dam to its confluence with Rock Creek is not adjudicated, and, therefore, water delivery is not controlled.

### Engineering Data

#### COONEY DAM :

Storage	24,195 acre-feet
Spillway	Width: 200'
	Capacity: Approximately 7,700 cfs
Gates	1 60" diameter slide gate and 1 60" diameter butterfly valve. Dry tower.
Height	97"
Length	2,260'
Type	Earthfill, 1,362,000 cu. yds.
Content Measuring Device	Cable down face of dam

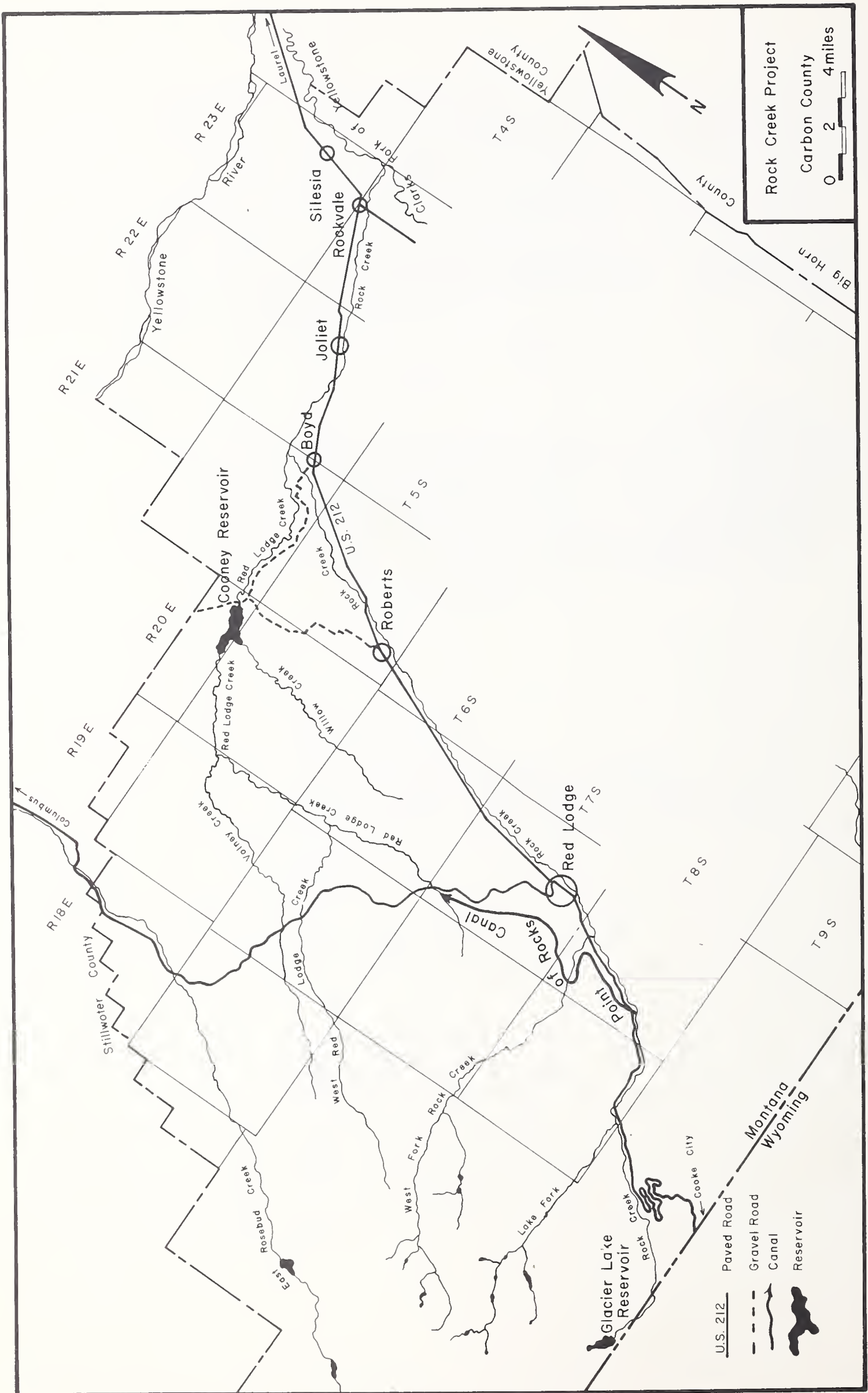
#### GLACIER DAM:

Storage	4,200 acre-feet
Spillway	Width: 50'
	Capacity: 1,450 cfs
Gates	1 48" x 48" slide gate
Height	65'
Length	260'
Type	Earthfill, 8,400 cu. yds.
Content Measuring Device	None



## CANALS:

Point of Rocks	2.3 miles Capacity: 50 cfs
Finn	9 miles Capacity: 25 cfs
Cottonwood	2 miles Capacity: 25 cfs
Pryde	8 miles Capacity: 40 cfs
R/W Cooney Reservoir Pool	790 acres deeded
Cooney Reservoir Land	1,082.07 acres deeded
Glacier Lake Reservoir	165.87 acres USFS permit
Point of Rocks Canal	40.70 acres deeded





ACRES FLOODED

1050 1040 1030 1020 1010 1000 990 980 970

800

700

600

500

400

300

200

100

0

SPILLWAY ELEV. 1046.0

SPILLWAY

ELEV. 1046.0

ACRES  
FLOODED

CONTOUR

AC FT.  
STORAGE

CONTOUR

975  
980  
985  
990  
995  
1000  
1005  
1010  
1015  
1020  
1025  
1030  
1035  
1040  
1045  
1046

0  
315  
520  
1065  
1875  
2505  
3520  
4955  
6520  
8445  
10570  
13320  
16390  
19445  
23390  
24190

20  
77  
103  
134  
158  
216  
262  
326  
384  
460  
504  
596  
646  
774  
790

CONTOUR

AREA CURVE

ACRE FEET STORAGE

24,000  
22,000  
20,000  
18,000  
16,000  
14,000  
12,000  
10,000  
8,000  
6,000  
4,000  
2,000  
0

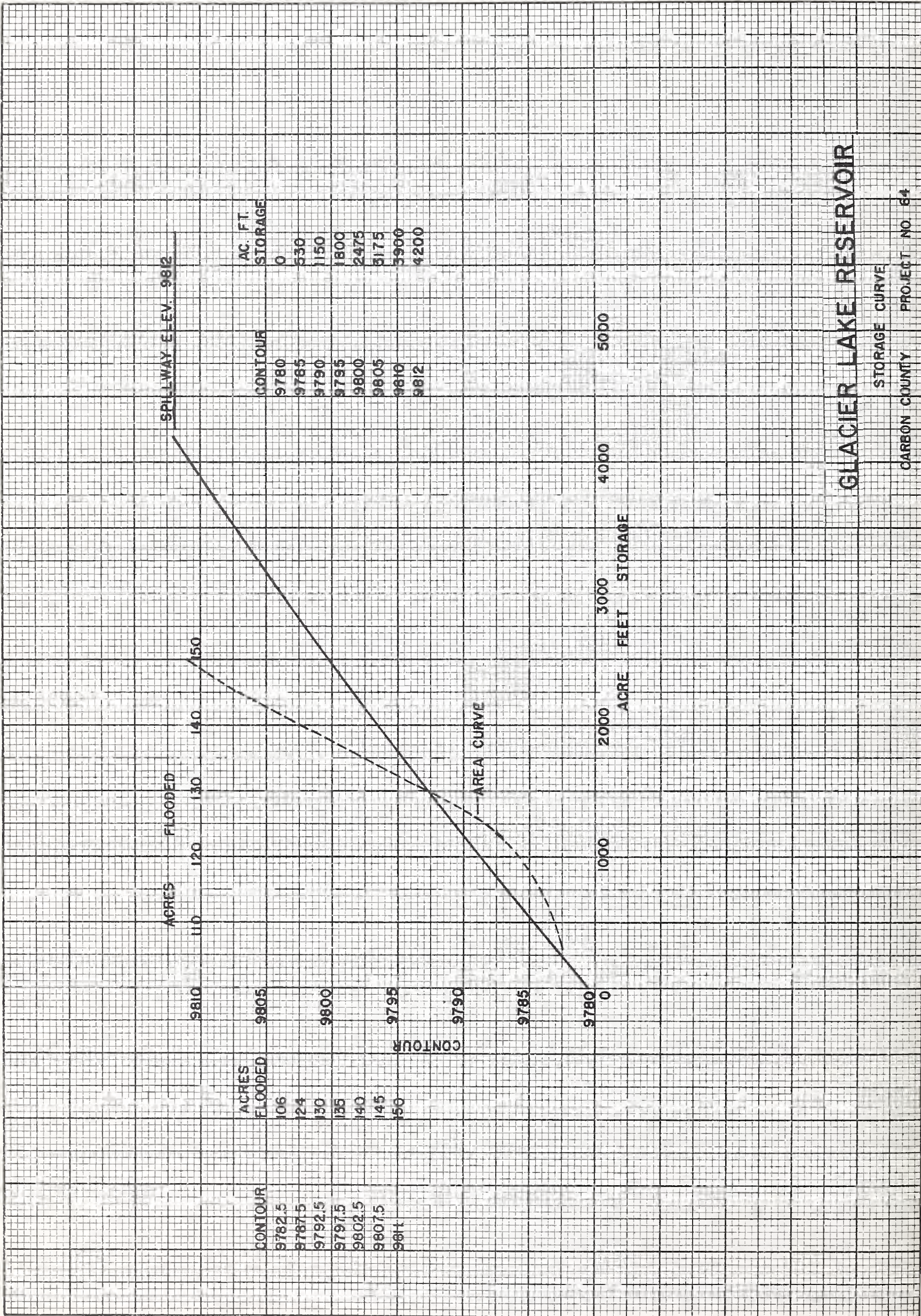
COONEY RESERVOIR

STORAGE CURVE

CARBON COUNTY

PROJECT NO. 64







# Ruby River/West Bench Canal/ Vigilante Canal

The Ruby River Project, consisting of a dam and reservoir on the Ruby River, is located six miles south of Alder in Madison County. The reservoir has a capacity of 38,850 acre-feet and floods an area of 950 acres when full. Water from this project is supplied to private diversions through the Ruby River and through two state-owned canals, the Vigilante and the West Bench. Construction of the dam, financed with a loan and grant from the PWA and with SWCB funds, was completed in 1938.

The West Bench Canal, which has a capacity of eighty-five cfs, is about twelve miles long and shares its first mile with the Vigilante Canal. Construction of the project was financed by the SWCB and was completed in 1950.

The Vigilante Canal, which has a capacity of 115 cfs, is about twenty-six miles long. Construction of the project, also financed by the SWCB, was completed in 1956.

Not all Ruby River reservoir water has been sold, partly due to the insufficient capacity of the Vigilante Canal. The Ruby River Water Users Association is experimenting with the operation plan developed by the SCS which uses snow survey and weather information to maximize flood storage and irrigation benefits. There have been some objections from downstream landowners to the Association's increased manipulation of flows in Ruby River.

During the September 1972 inspection at Ruby Dam, it was found that most of the previous years' dam safety recommendations had been carried out. Repairs have been made to the gatehouse, top deflector on the operating gate, outlet structure, weir, and the surface of the spillway. Only minor maintenance is now necessary. The West Bench Canal Water Users Association has operated and maintained its canal satisfactorily. Although the Vigilante Canal at one time was receiving poor maintenance and consequently deteriorated, the Vigilante Canal Water Users Association is returning the canal to satisfactory condition.

## Water Measurement

Outflows from Ruby Dam are measured by a USGS gaging station. Monthly water surface elevations are recorded by the Department. Water diversions from the river are controlled by a water commissioner.

Flows into the West Bench and Vigilante canals are recorded by a Department gaging station. Water is divided among the water users by a ditchrider

with the aid of measuring devices.

### Engineering Data

#### DAM:

Storage	38,850 acre-feet
Spillway	Width: 125'
	Capacity: 30,000 cfs
Gates	1 72" diameter slide gate and 1 72" diameter butterfly valve. Wet tower.
Height	111'
Length	846'
Type	Earthfill, 714,394 cu. yds.
Content Measuring Device	Cable down face

#### CANALS:

Vigilante	25.0 miles
	Capacity: 115 cfs
	Measuring Device: Water Stage Recorder

West Bench	11.9 miles
	Capacity: 85 cfs
	Measuring Device: Water Stage Recorder

Main	0.8 miles
	Capacity: 201 cfs
	Measuring Device: None

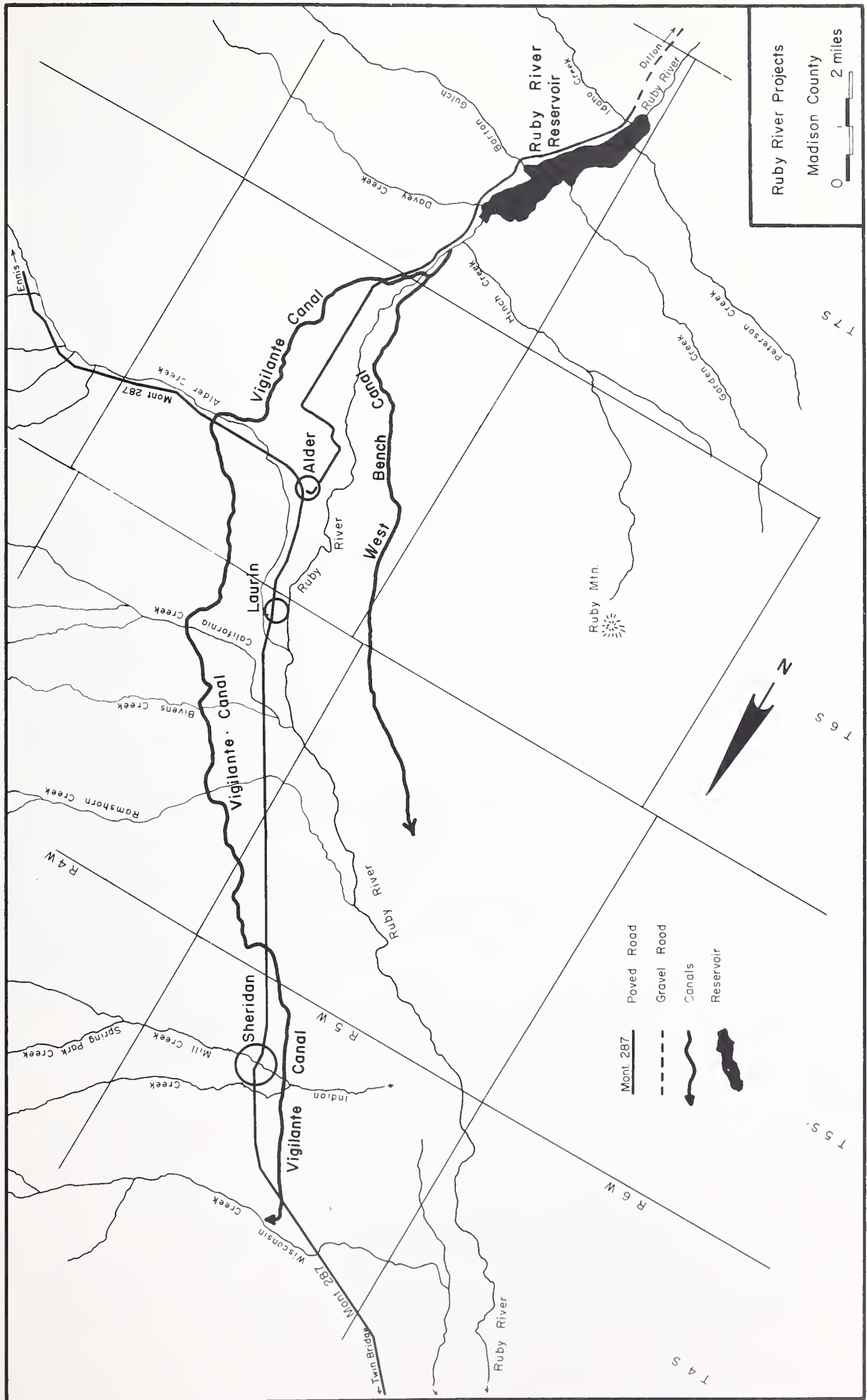
R/W Reservoir Pool	970 acres deeded
Reservoir Land	161.61 acres deeded

Vigilante Canal	263.54+ acres partially deeded
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West Bench Canal	161.59 acres partially deeded
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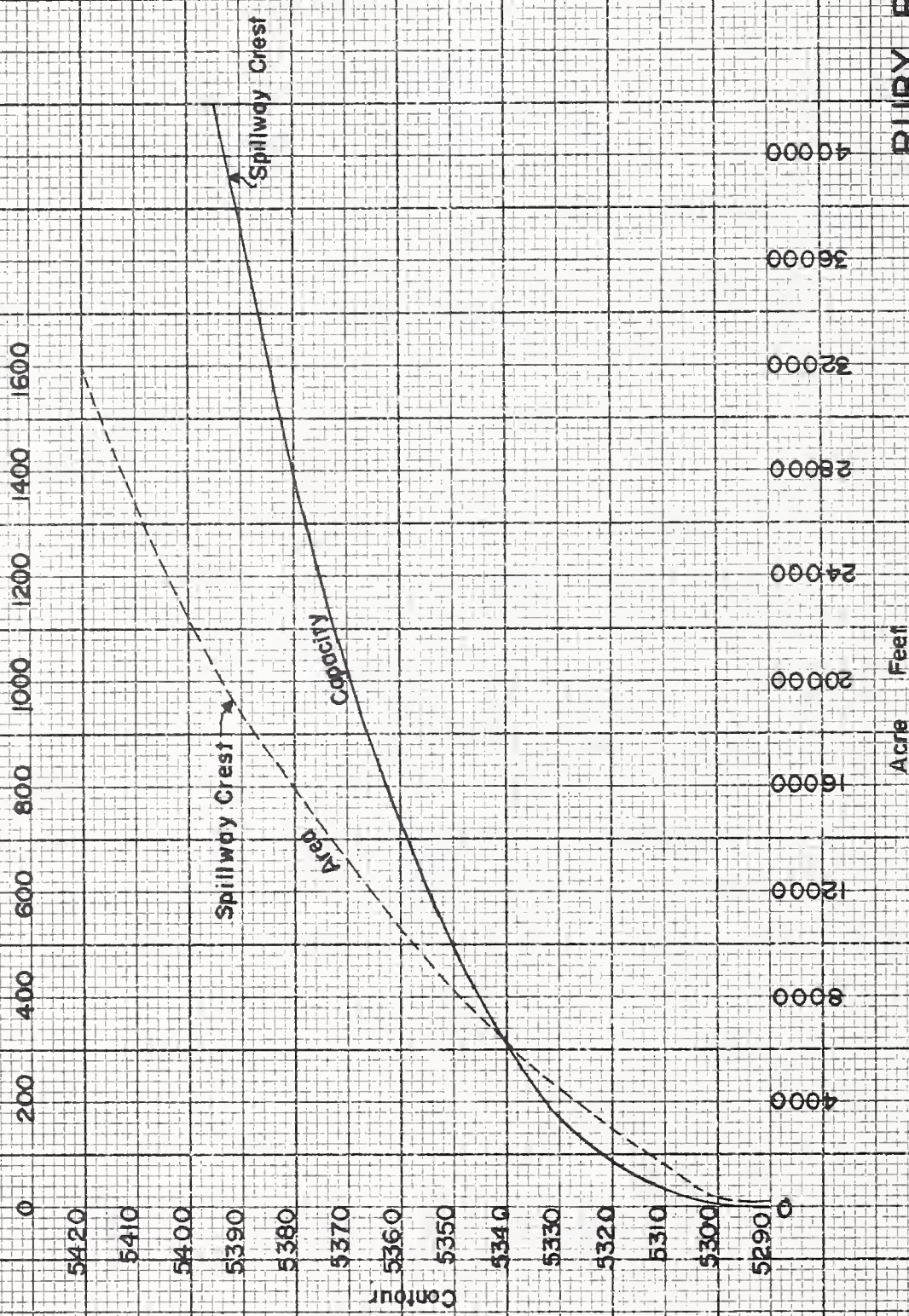
NOTE: R/W for West Bench Canal includes the head end of Vigilante Canal and all of the Main Canal.







RESERVOIR CAPACITY		Acre Feet	
Elevation	Acres	Acres	Feet
5290	6	0	0
5300	14	100	100
5320	144	1680	1680
5340	312	6240	6240
5360	527	14630	14630
5380	804	27940	27940
5390	948	37037	37037
5392	970	38950	38950
5395	1000	41911	41911
5400	1118	47200	47200



**RUBY RESERVOIR**  
 STORAGE CURVE  
 MADISON COUNTY PROJECT NO. 76



# Sidney

This project, located near Sidney in Richland County, consists of three main pumping stations on the Yellowstone River, four relift pumps, and an auxiliary river pump. There are also canals and related structures. The project was originally built in 1939 with a loan and grant from the PWA and with SWCB funds. Reconstruction of the project, begun in 1971, has been completed at a cost of over \$1,200,000, fifty percent of which was granted through the Public Law 566 (Small Watershed Protection) program by the SCS. The remainder was financed with loans from FHA and the MWRB.

The project is complete except for the construction of several badly needed drainage ditches. The Sidney Water Users Association constructs a portion of these ditches each year as funds permit.

In 1968, as a part of the reconstruction proposal, an economic analysis of the project was made by the SCS. Its investigation concentrated primarily on agricultural water management and secondarily on flood prevention. A determination was made that each part of the watershed project was economically feasible. The benefits were found to be of such magnitude that a detailed analysis of cost savings was deemed unnecessary.

A contract between the Department and the Association covering the state's investment through fiscal year 1973 was signed in 1974. Present water cost for principal and O&M is \$5 per acre-foot (\$15 per acre).

Information assembled as a result of the reconstruction of the project is sufficient to complete the project critique.

## Water Measurement

Diversions from the Yellowstone River are calculated from the pump discharges. Water deliveries are made by a ditchrider without the aid of measuring devices.

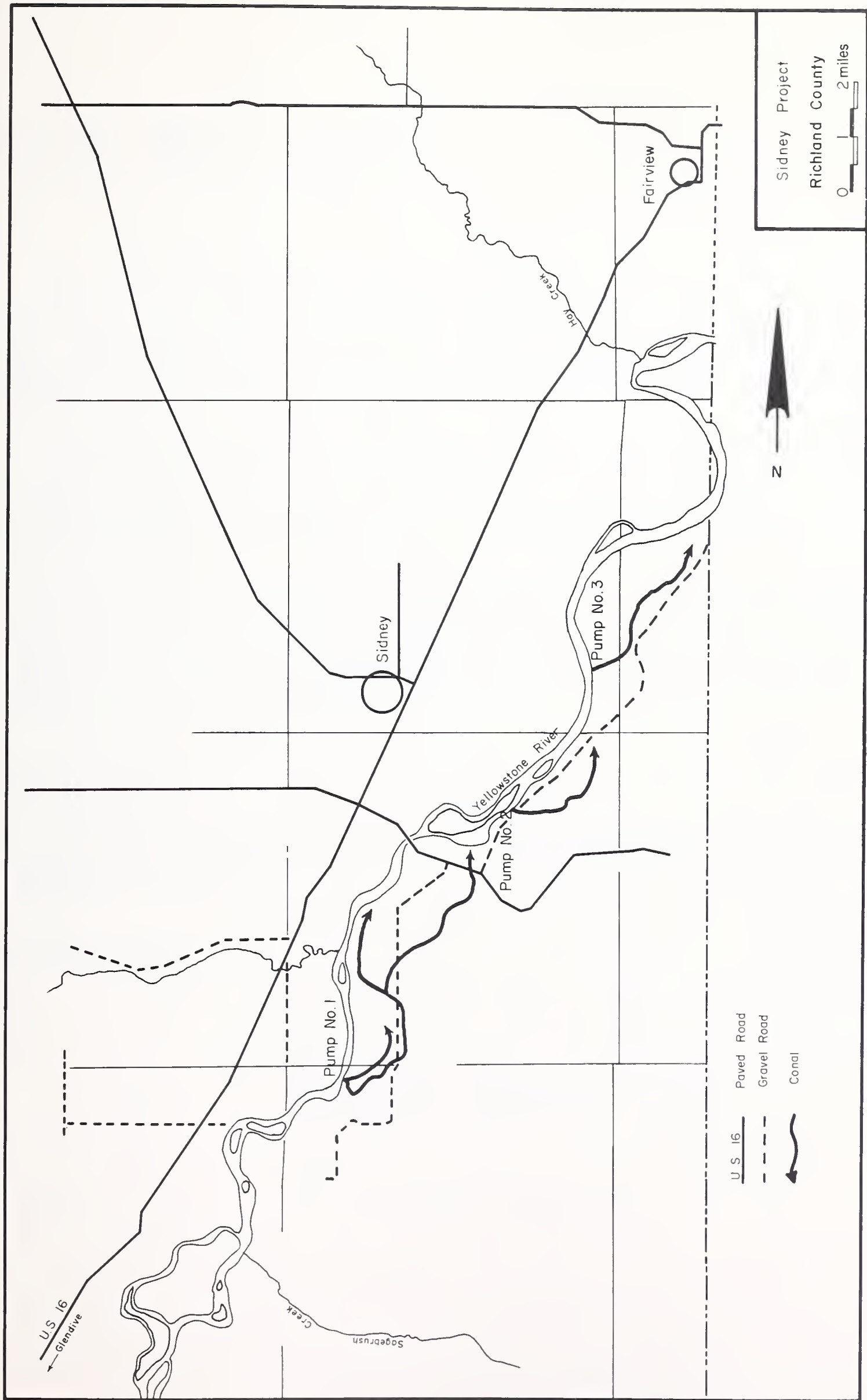
## Engineering Data

### YELLOWSTONE RIVER PUMP SITES:

	<u>Pumps</u>	<u>Discharge</u>	<u>Head</u>	<u>Acres Irrigated</u>
River Pump Site #1	1 100 H P	13.0 cfs	48.3 ft.	460
	3 200 H P	51.12 cfs	79.0 ft.	875



	<u>Pumps</u>	<u>Discharge</u>	<u>Head</u>	<u>Acres Irrigated</u>
Relift Pump Site #1-1	1 30 H P	9.0 cfs	70.0 ft.	370
Relift Pump Site #1-2	2 100 H P	20.8 cfs	66.7 ft.	870
River Pump Site #1-A	2 75 H P	29.1 cfs	75.0 ft.	210
Relift Pump Site 1-A-1	2 40 H P	22.8 cfs	80.0 ft.	790
River Pump Site #3	2 75 H P	30.0 cfs	36.5 ft.	1160
Relift Pump Site #3-1	1 15 H P	6.0 cfs	16.8 ft.	80







# South Side Canal

This project diverts water from the North Fork of Smith River. Most of that water is North Fork of Smith River Reservoir storage water; the rest comes from a Department-held flood water right from the river itself. The canal, with a capacity of sixty cfs, is about thirteen miles long and is located to the east of White Sulphur Springs in Meagher County. Construction, financed with SWCB funds, was completed in 1950.

The South Side Canal Users Association, faced with a water shortage due to severe leakage of the canal, asked the SCS and the Department for a design to line the canal. The urgency of the situation was made clear when an adjacent landowner threatened to file an injunction against the Association because the seepage was preventing him from farming his land.

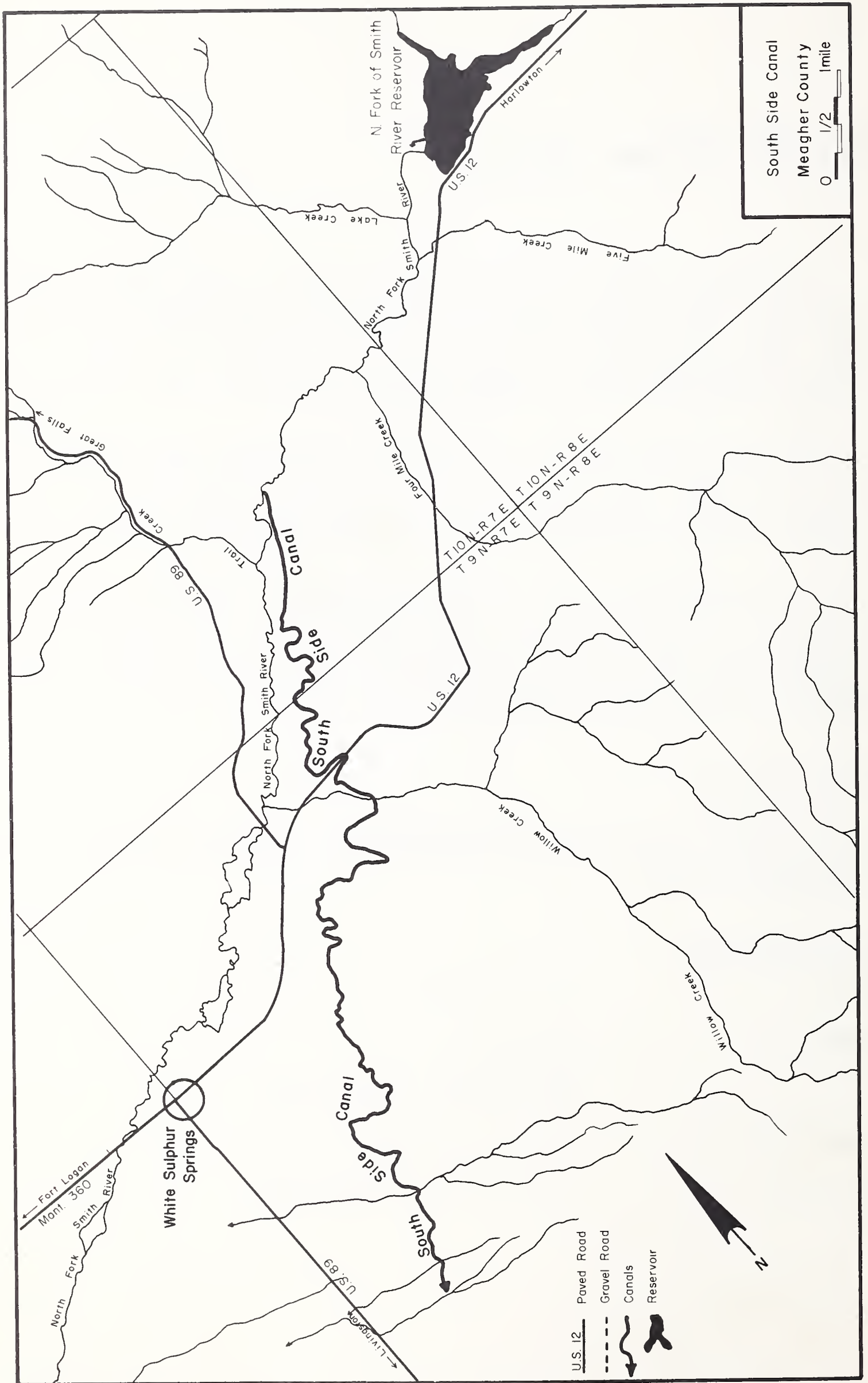
The Department and the SCS studied the project to determine the best alternative. Bentonite lining of approximately three miles of the canal was selected as the most economical repair method, despite its relatively short effective life (approximately fifteen years). Financing was obtained from the ASCS, FHA, and the Department, and repairs were completed last fall (1976) at a total cost of \$73,400.88.

## Water Measurement

Diversions from the river are measured by a nonrecording measuring device. Water is divided among the water users by a water commissioner with the aid of measuring devices.

## Engineering Data

DAM	Direct Diversion
CANAL	12.5 miles Capacity: 60 cfs 2 30" diameter slide gates
Measuring Device	Water stage recorder
R/W Canal	66.19+ acres partially deeded



# Theboe Lake

This project consists of a dam and storage reservoir located eighteen miles west of Choteau in Teton County. It has a storage capacity of 830 acre-feet, and the water is diverted to the lake through a short canal from the South Fork of Willow Creek. In 1936, the water was being used to irrigate about five hundred acres of land along Willow Creek. The present condition of the project is not well known, since the Department has not been involved in the project for several years.





# Tongue River

The Tongue River Project comprises a dam and storage reservoir about ten miles north of the Montana-Wyoming state line near Decker in Big Horn County. The reservoir has a capacity of 69,439 acre-feet and floods an area of 3,497 acres when full. In addition to its agricultural use, the reservoir has received substantial recreational use, and water has been sold for industrial purposes. Construction of the project, which was financed with a loan and grant from the PWA and with SWCB funds, was completed in 1940.

Serious damages were found in the outlet tunnel of the dam during the October 1973 dam safety inspection. Cavitation had eroded the concrete floor of the tunnel; a large steel plate had pulled off the wall of the transition area below the operating gate.

Originally, repairs were scheduled for the fall of 1974. Since the repairs involved shutting off the flow in the Tongue River for about five weeks, it was necessary for the Department to prepare a draft EIS, Proposed Repairs to Tongue River Dam (October 1974, Helena). Although it was determined in the EIS that interrupting the flow in the Tongue River could have a serious impact on the fisheries resource, the economic cost of maintaining a minimum flow (the Montana DFG recommended 100 cfs) would be excessive. As a result, the DFG asked the Department to delay the repairs until the fall of 1975 to allow the DFG to complete a two-year fisheries study begun in the summer of 1974. An inspection in September 1974 determined that the repairs could be delayed one year. To protect the Association, the Department agreed to pay any additional costs of repairs which exceeded the 1974 estimated cost as a result of the one-year delay.

Following considerable public attention just before the repairs were scheduled to begin (fall 1975), many organizations and individuals offered to donate money to meet the cost of providing downstream flows, and Crisafulli Pump Company Inc. agreed to provide flows at a reduced cost. With an additional donation by the Department, it was possible to provide approximately fifteen to twenty-five cfs during the repairs, which were completed during the winter of 1976. The total cost of repairs was \$28,026.30; the cost of providing downstream flows was nearly \$33,000, of which the Department paid over \$13,000.

The use of the spillway is being avoided because of the large amount of repair work needed to restore the structure. At present there is spalling and cracking on the top of the spillway walls, and part of the spillway floor has uplifted. Deterioration in some places has exposed the steel reinforcement. The spillway is on a poor foundation, and should have a larger capacity in order to handle the flow which may be expected from this reservoir.

As a result of the growing concentration of mining operations near the project, it has become increasingly important for the Department to accurately determine the status of its land ownership and right-of-way holdings. The Department is now carefully examining its records to answer these legal questions.

### Increased Storage on the Tongue River

In 1968, the Department contracted with Bechtel Corporation, an engineering firm headquartered in San Francisco, to investigate the possibility of additional storage on the Tongue River. No sites were considered which would back water across the state line into Wyoming. Bechtel's proposals included (1) increasing the height of the present dam, and (2) building a new dam downstream from the present structure. At that time, the new dam appeared to be the more feasible alternative. The additional water would probably be used for coal development in the area.

The study determined the firm annual yield (FAY) of the present reservoir to be 40,000 acre-feet. (The FAY is the maximum volume of water that could be released from the reservoir each year and still ensure a constant supply of water during an extended drought.) At the time of the report there were water purchase contracts for less than that amount, so the Department allowed agricultural users three years to purchase new contracts. In March of 1972, after several new agricultural contracts had been signed, a contract for 4,175 acre-feet (the unsold portion of the 40,000 acre-foot FAY) was established with the Montana Power Company for industrial use.

The 1968 report indicated that raising the existing dam might be an economically feasible alternative if an agreement could be reached to flood land in Wyoming. For this reason, the Department in 1976 contracted R.C. Harlan and Associates, another San Francisco engineering firm, to prepare cost estimates (1) for raising the dam and (2) for improving the existing dam to present-day standards. The cost estimates made by Bechtel in 1968 were updated and compared with the estimates made the new alternatives. The cost estimates and associated data are found in Tongue River Project Modification Feasibility Study (R.C. Harlan and Associates, October 1976). Some of the results are listed in table 8. Additional cost items which must be added to this estimate include land and land rights, state of Montana administrative costs, environmental investigations and reports, interest, costs of financing, and escalation of costs until project construction begins.

### Water Measurement

Inflows and outflows from the reservoir are measured at USGS gaging stations above and below the reservoir. Downstream flows are measured at USGS gaging stations at Brandenburg and Miles City. Monthly water surface elevations are recorded by the Department. Because Tongue River is not adjudicated, control of diversions from the river is impossible.



TABLE 8

## COMPARISON OF ALTERNATIVES FOR INCREASING STORAGE ON THE TONGUE

Alternative	Cost (\$)	Firm Annual Yield (acre-feet)	Reservoir Area Flood Pool (acres)
Modify existing reservoir at present elev. 3424.4'	28,754,000	42,000	6,700
Modify existing reservoir to storage elev. 3438	32,130,000	67,500	8,100
Modify existing reservoir to storage elev. 3465	32,669,000	100,000	10,400
Construct Stage I High Tongue River Dam downstream to elev. 3438	63,501,000	100,000	11,200

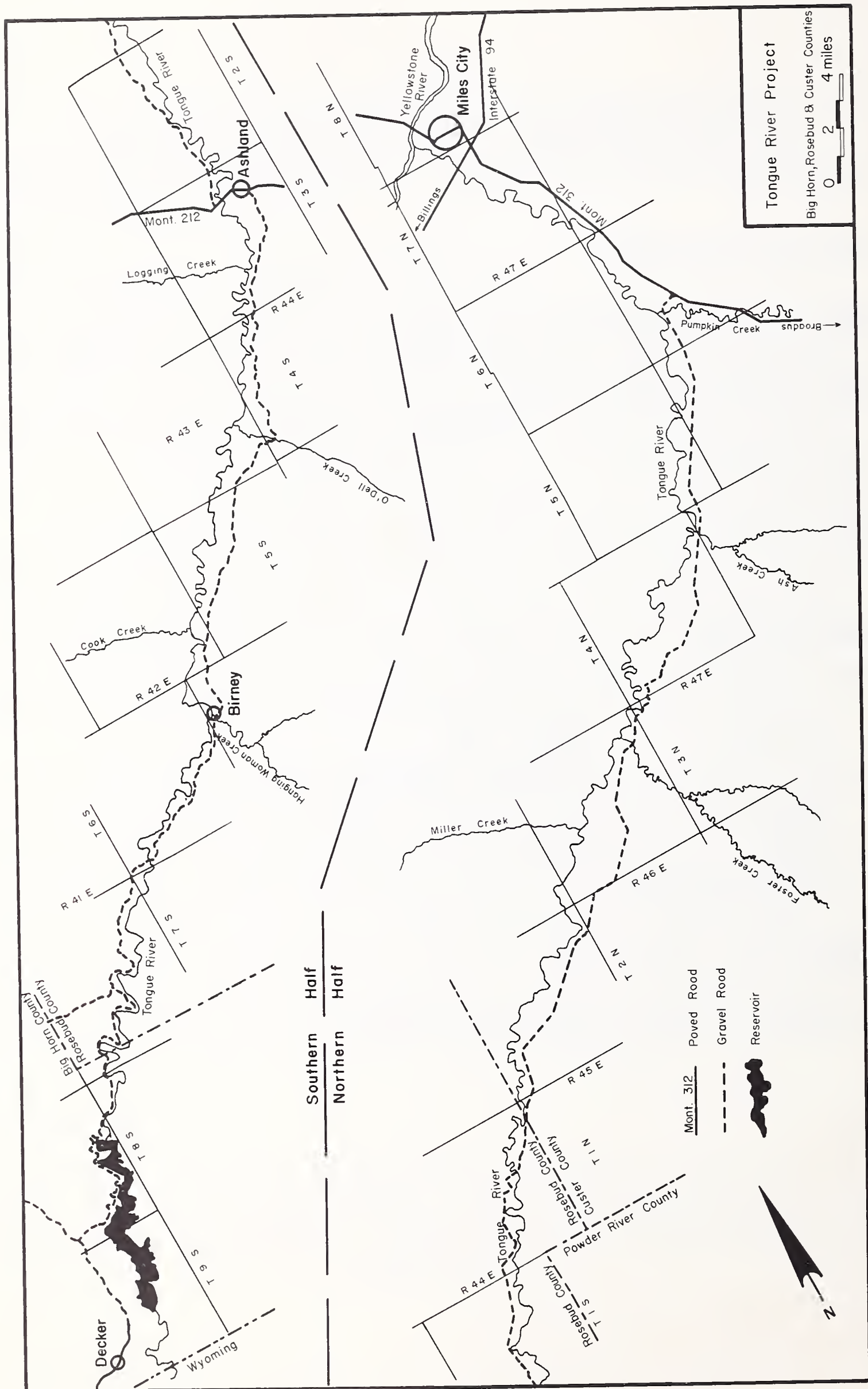
Engineering Data

## DAM:

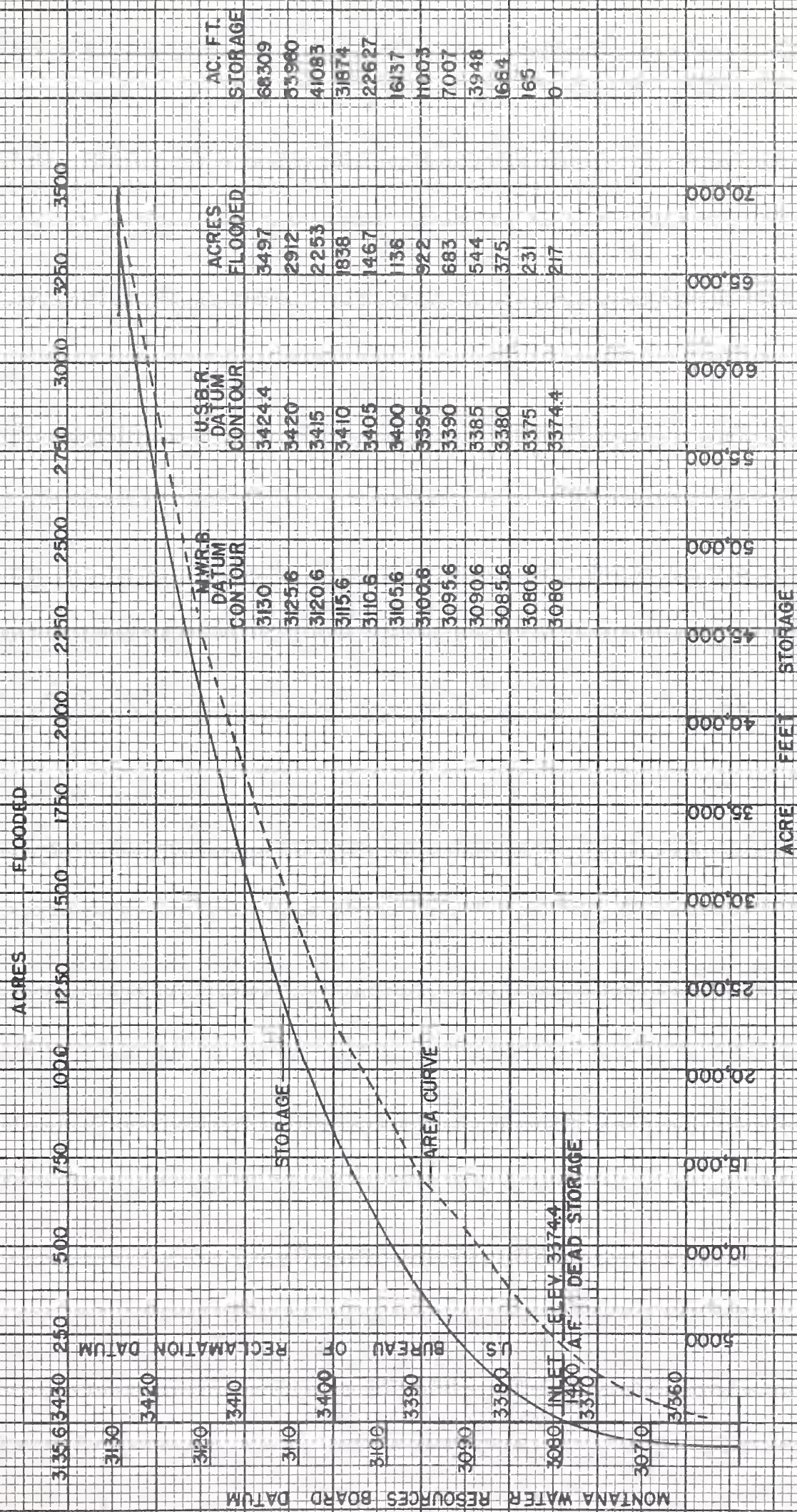
Storage	69,439 acre-feet
Spillway	Width: 350'
	Capacity: 60,000 cfs
Gates	2 6' x 12' slide gates. Wet tower.
Height	91'
Length	1.824'
Type	Earthfill, 1,225,000 cubic yards
Content Measuring Device	Cable down face

CANALS:	None
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R/W Reservoir Pool	3,497 acres deeded
Reservoir Land	2,326.35 acres deeded







# TONGUE RIVER RESERVOIR

STORAGE CURVE  
BIG HORN COUNTY PROJECT NO. 29





# Upper Musselshell

This project consists of three dams, two storage reservoirs with a total capacity of 30,134 acre-feet, and canals with a combined length of fifty-two miles. Bair Reservoir is located on the North Fork of the Musselshell River in Meagher County about one-half mile west of Checkerboard, and Martinsdale Reservoir, an offstream storage reservoir, is located one mile southeast of Martinsdale in Meagher and Wheatland counties. Two dams were necessary at the Martinsdale site. The project, which was financed by a loan and grant from the PWA supplemented by SWCB funds, was completed in 1939. Both reservoirs receive recreational use.

The outlet gates on both Bair and Martinsdale dams were repaired in 1974 using an epoxy steel putty to cover eroded areas on the gates. Such erosion has been known to accelerate quickly if repairs are not made. Surface repairs are needed on the spillway at Bair Reservoir. Riprap is needed on the face of the dam to prevent further wave erosion. Safety modifications have been made to the gate towers on both dams to make work safer for the damtender.

Checkerboard Canal, which feeds Bair Reservoir from Checkerboard Creek, was rebuilt during the fall of 1974. Some additional measures to prevent erosion must be completed before the canal can be used, however.

Considerable damage was done to the diversion dam and part of the supply canal for Martinsdale Reservoir during the flood in 1975. Disaster aid funds were obtained from the Federal Disaster Assistance Administration to complete the repairs to the structures.

The directors of the Upper Musselshell Water Users Association intend to control which land is eligible for future water contracts. Some areas of the project can only be served by Bair Reservoir, which is nearly sold out, and the directors want to prevent its being oversold. In addition, they will charge a higher price for all future contracts so that they can repay the state's investment without marketing the entire capacity of the reservoirs. In this way, a reserve pool will be maintained to allow for evaporation and seepage losses and help keep a supply in dry years.

## Water Measurement

The Department maintains gaging stations below Bair Reservoir on North Fork Diversion Canal, two on Martinsdale Supply Canal, one on Martinsdale Outlet Canal, and one on Two Dot Canal. The USGS maintains gaging stations on the North Fork above Bair Reservoir, on the South Fork above Martinsdale Supply Canal, and on the Musselshell River at Harlowton. Monthly water surface

elevations at Bair and Martinsdale reservoirs are recorded by the Department. Several of the turnouts on the canals have measuring devices. Because the Musselshell River is not adjudicated, control of the diversions from the river is impossible.

### Engineering Data

#### BAIR DAM:

Storage	7,029 acre-feet
Spillway	Width: 65'
	Capacity: 6,000 cfs
Gates	1 48" diameter slide gate and 1 48" diameter butterfly valve.
	Dry tower.
Height	100'
Length	538'
Type	Earthfill, 241,600 cu. yds.
Content Measuring Device	Cable down face

#### MARTINSDALE DAM:

Storage	23,105 acre-feet
Spillway	Width: 10'
	Capacity: 600 cfs
Gates	1 54" diameter slide gate and 1 54" diameter butterfly valve.
	Dry tower.
Height	96' (North) 49' (East)
Length	1,000' (North) 1.635' (East)
Type	Earthfill, 716,500 cu. yds.
Content Measuring Device	Elevation pins down face

#### CANALS:

Checkerboard	2.9 miles
	Capacity: 38 cfs
	Measuring Device: None
N. Fork Diversion	11.7 miles
	Capacity: 105 cfs
	Measuring Device: Water Stage Recorder
Martinsdale Supply	2.41 miles
	Capacity: 408 cfs
	Measuring Device: Water Stage Recorder
Martinsdale Outlet	2.57 miles
	Capacity: 333 cfs
	Measuring Device: Water Stage Recorder



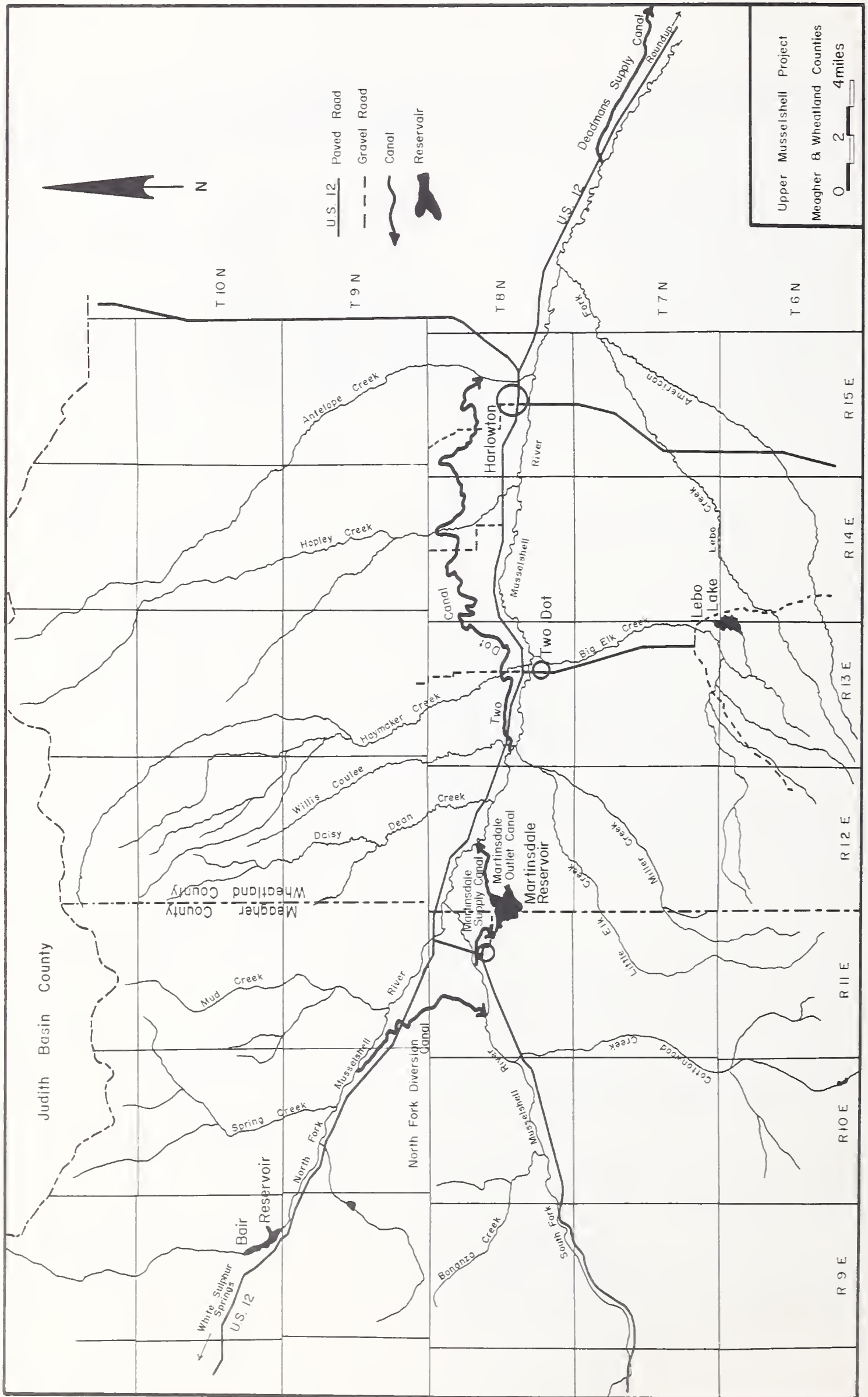
Two Dot Canal

32.12 miles

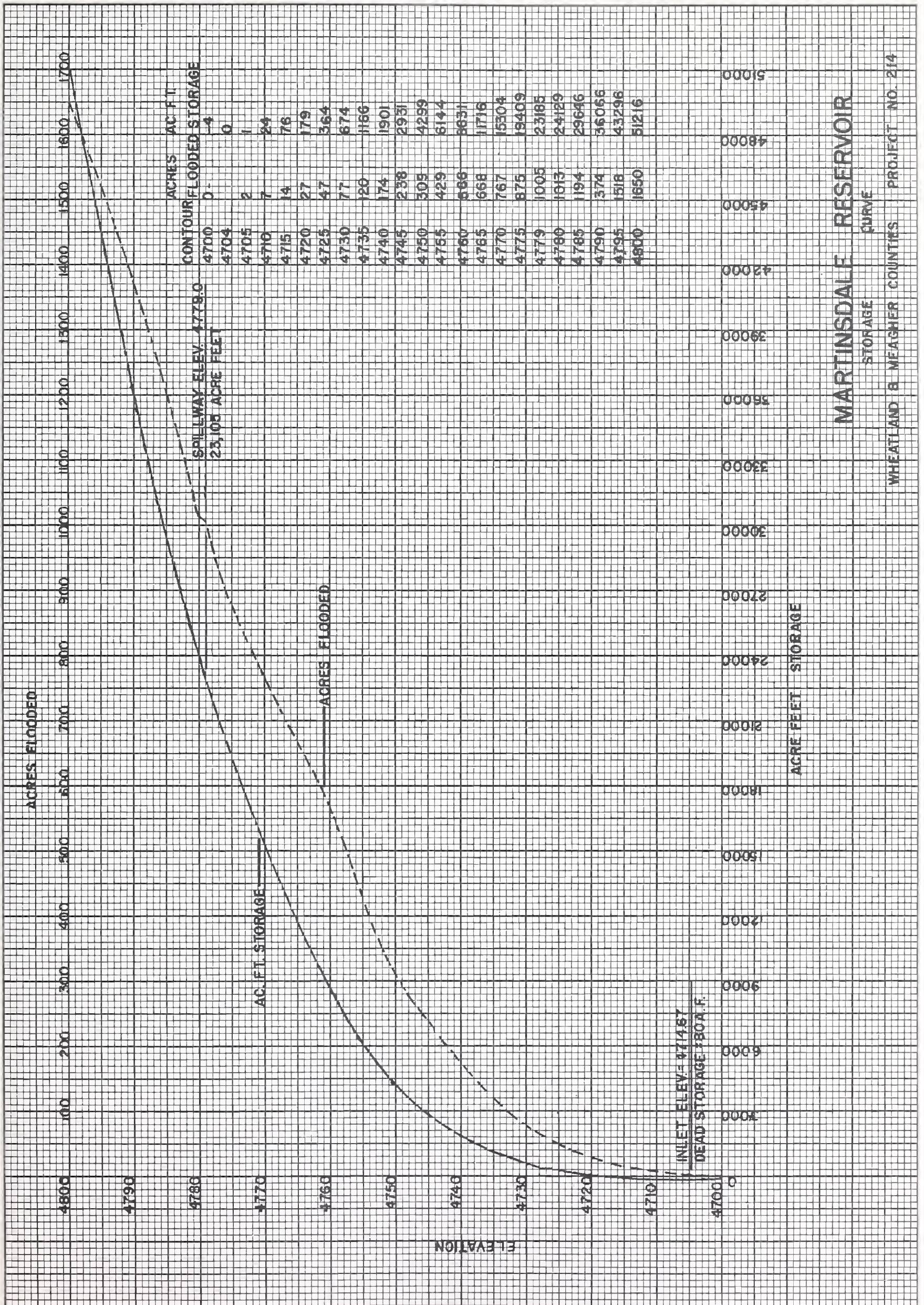
Capacity: 122 cfs

Measuring Device: Water Stage Recorder

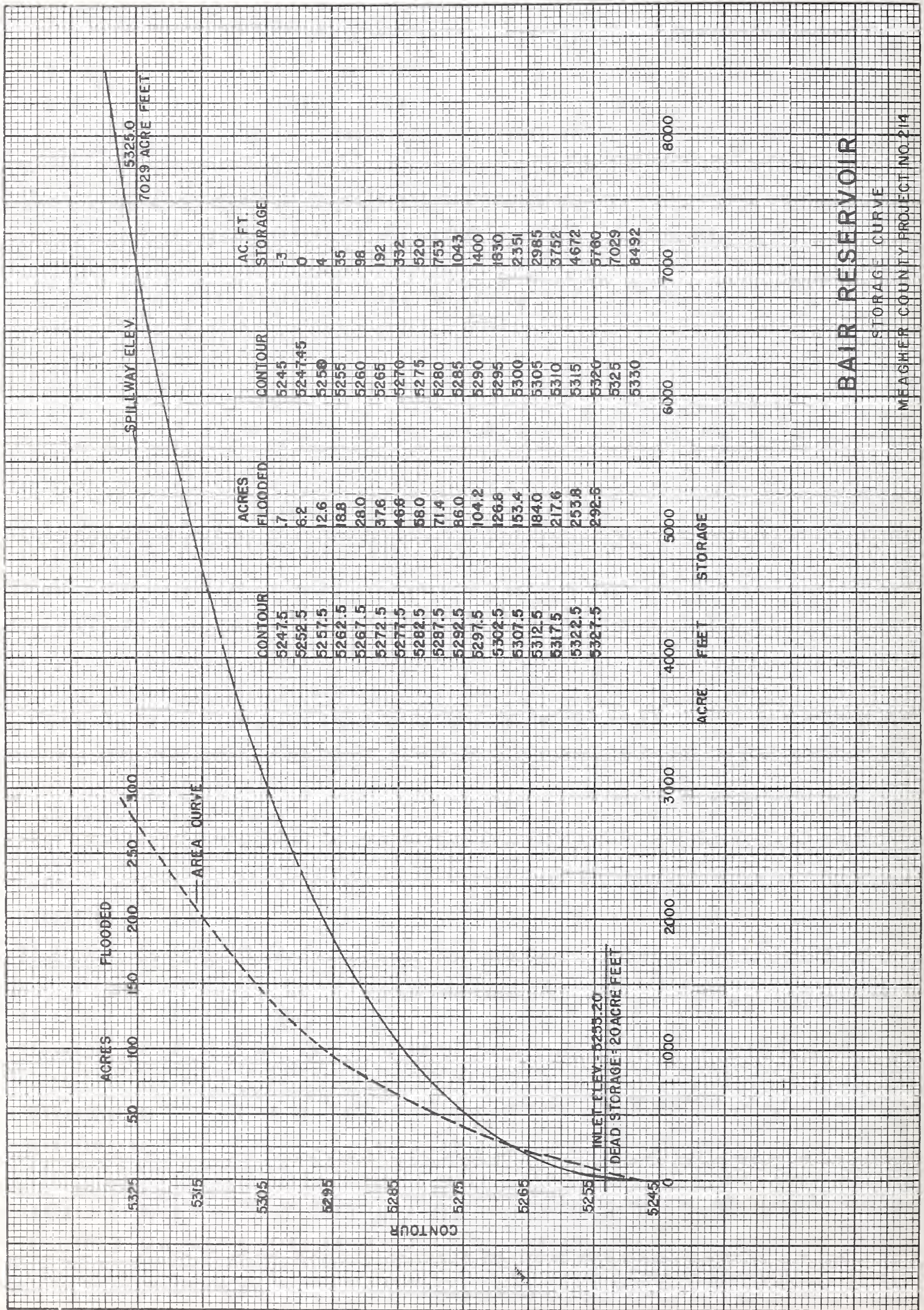
R/W	Bair Reservoir Pool	292 acres deeded
	Bair Reservoir Land	135.72 acres deeded
	Martinsdale Reservoir Pool	1,050 acres deeded
	Martinsdale Reservoir Land	349.54 acres deeded
	Checkerboard Canal	32.76 acres deeded
	N. Fork Diversion Canal	97.74 acres deeded
	Martinsdale Supply Canal	37.40 acres deeded
	Martinsdale Outlet Canal	26.85 acres deeded
	Two Dot Canal	296.10 acres deeded













# Valentine

The Valentine Project was located on Blood Creek near the town of Valentine about seventy miles northeast of Lewistown on the county line between Fergus and Petroleum counties. It consisted of a dam and 2,500-acre-foot reservoir. The Valentine Water Users Association was incorporated but has never been active because the dam washed out in June 1962.

In 1971, the Department of State Lands (DSL) agreed to administer the lands of this project.





# Warhorse

The Warhorse Project, sometimes called the Winnett Irrigation Project, is located to the northwest of Winnett in Petroleum County. It includes an offstream storage reservoir with a capacity of 19,250 acre-feet, a diversion canal from Fords Creek, a distribution canal, an outlet canal, and an additional small reservoir known as Little Bear Lake. Construction, financed with federal and SWCB funds, was completed in 1938.

Maintenance of the distribution canal became excessively expensive, and that portion of the project was abandoned; it has now washed out below Buffalo Creek. Although there are only two users of project water, there is substantial local interest in repairing the project and using the stored water. The lake is given a considerable amount of recreational use and is part of the Warhorse National Wildlife Refuge.

The Department in 1973 considered releasing the Warhorse Project to the Winnett Irrigation Company, the water user group who originally used the project. The dam was inspected and recommendations for its repair were made. Before making any decisions regarding the proposal to release the project, the Department asked for public input concerning the future use of the project. Alternative proposals for its use were received from the Bureau of Land Management, U.S. Sport Fisheries and Wildlife Service, and the Winnett Irrigation Company. The federal agencies proposed to operate the facilities primarily for fisheries and wildlife, and the Winnett Irrigation Company proposed to use them primarily for irrigation. There was public support for each of the proposals. Investigations were made to determine whether an operation plan could be developed whereby wildlife and irrigation uses could both be enhanced. It was determined that both uses could benefit during some years, but that in dry years irrigation would dry up the reservoir, thus reducing wildlife benefits. Since the project deed gives the Winnett Irrigation Company first priority of ownership, the decision was made to release the project to the Company, provided it agrees to make the necessary repairs. The irrigators agreed to try to cooperate with wildlife interests as much as possible.

It is expected that the project will be released as soon as the necessary administrative steps can be taken.

## Water Measurement

The project has no measuring devices.

## Engineering Data

### DAM:

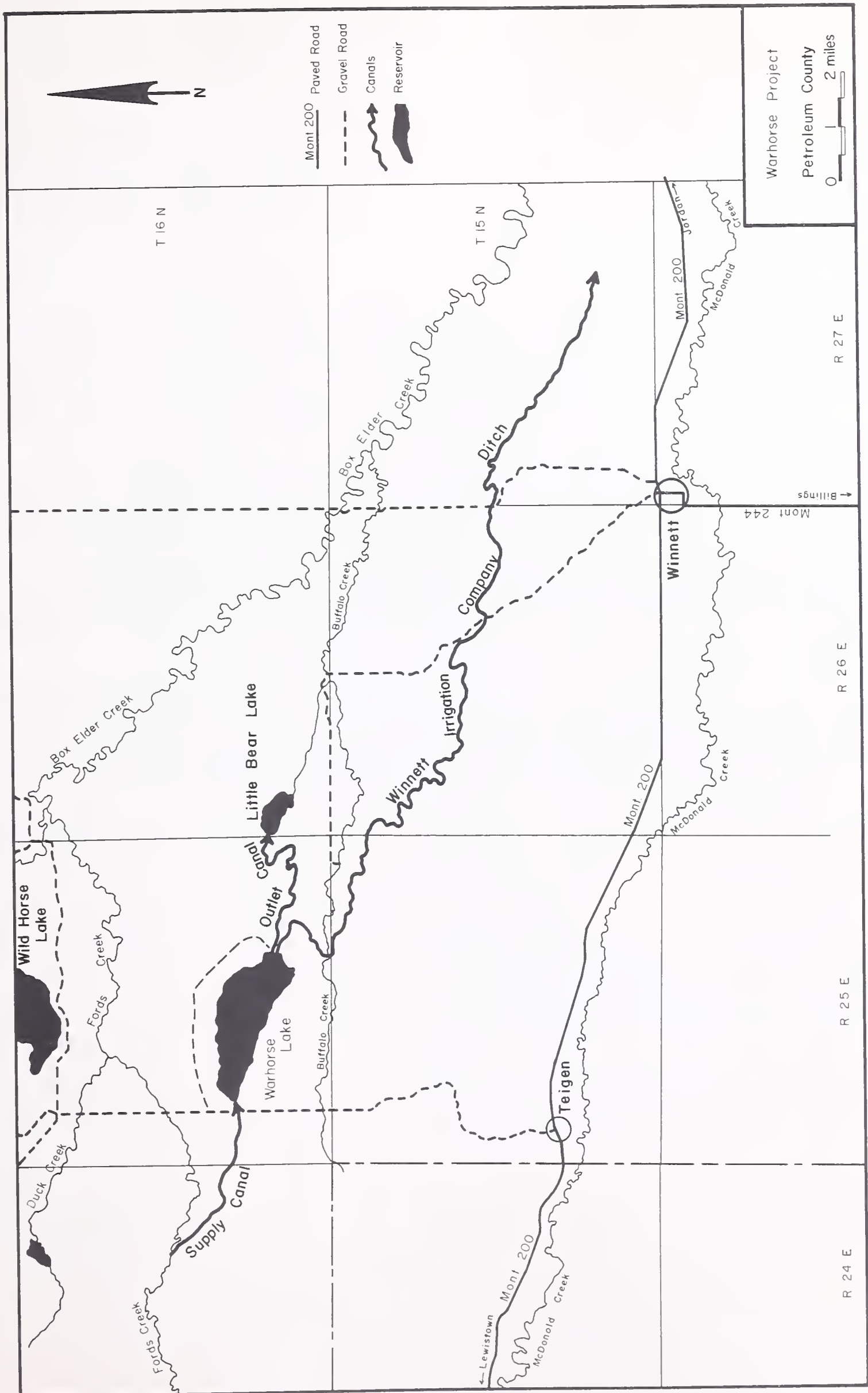
Storage	19,250 acre-feet
Spillway	None
Gates	1 48" diameter slide gate. Wet tower.
Type	Earth and gravel fill
Content Measuring Device	Tape in tower

### CANALS:

Supply	4 miles
	Capacity: 1,200 cfs

Outlet	3.6 miles
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R/W Reservoir	2,320.0 acres deeded
Canals	29.0 acres deeded







# Willow Creek

The Willow Creek Project consists of a dam and storage reservoir with a capacity of 18,000 acre-feet located about four miles east of Harrison in Madison County. There are no canals on the project, and the diversions are all private. Financing was accomplished through federal grants and loans and state general funds. Construction was completed in 1938.

The 1974 dam safety inspection at Willow Creek Reservoir determined that some safety features, such as modification of the floor grating and installation of a safety line on the ladder, should be added to the outlet gate tower to protect the damtender from injury.

Because the Willow Creek Water Users Association has operated and maintained the project satisfactorily, little Department involvement has been necessary.

## Water Measurement

There are fifteen turnouts on the project, two of which have Parshall flumes. All diversions are private.

## Engineering Data

### DAM:

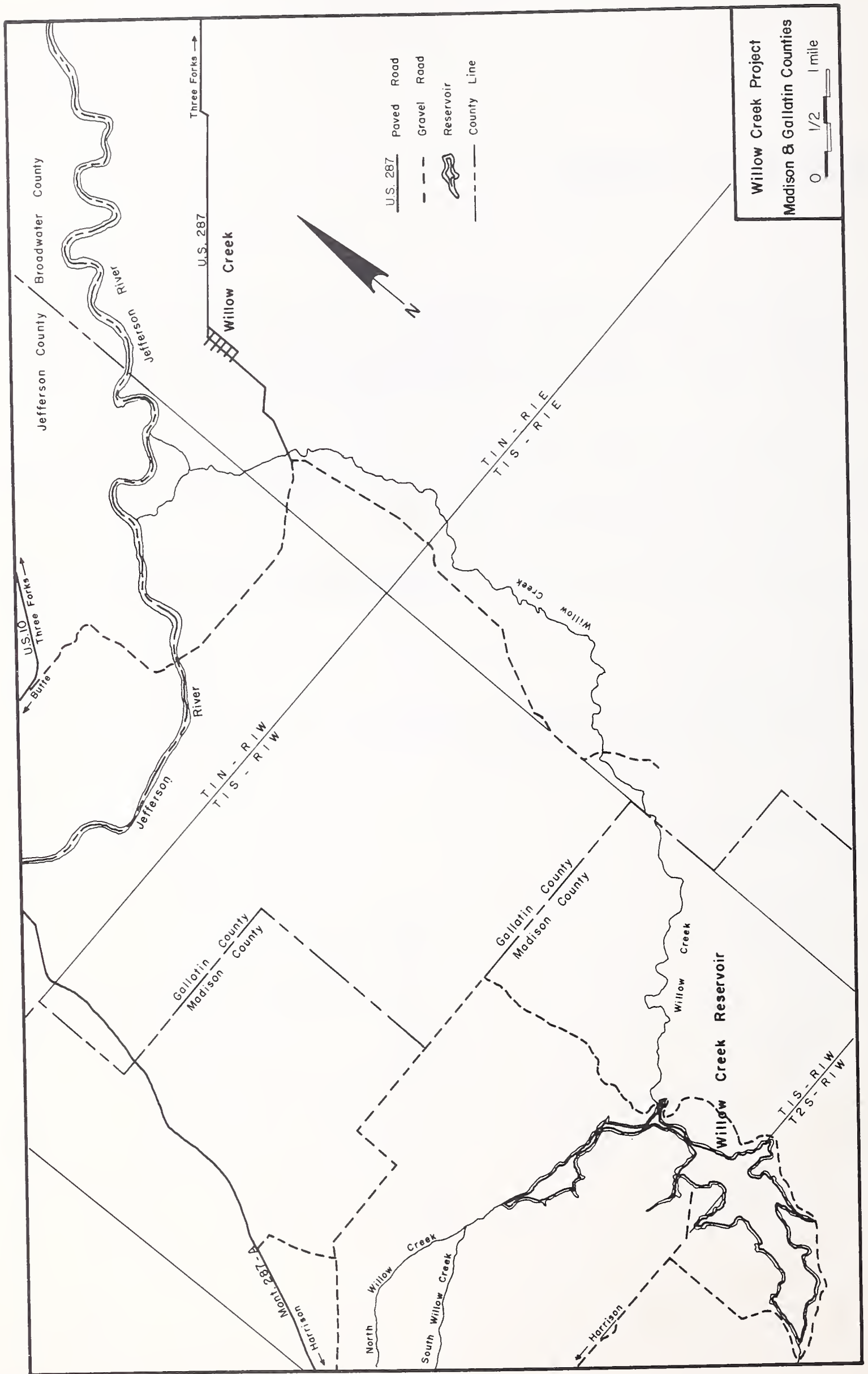
Storage	18,000 acre-feet
Spillway	Width: 120'
	Capacity: 8,000 cfs
Gates	1 54" diameter slide gate and 1 54" diameter butterfly valve. Dry tower.
Height	105'
Length	453'
Type	Earthfill, 176,000 cu. yds.
Content Measuring Device	Cable down face

### CANALS:

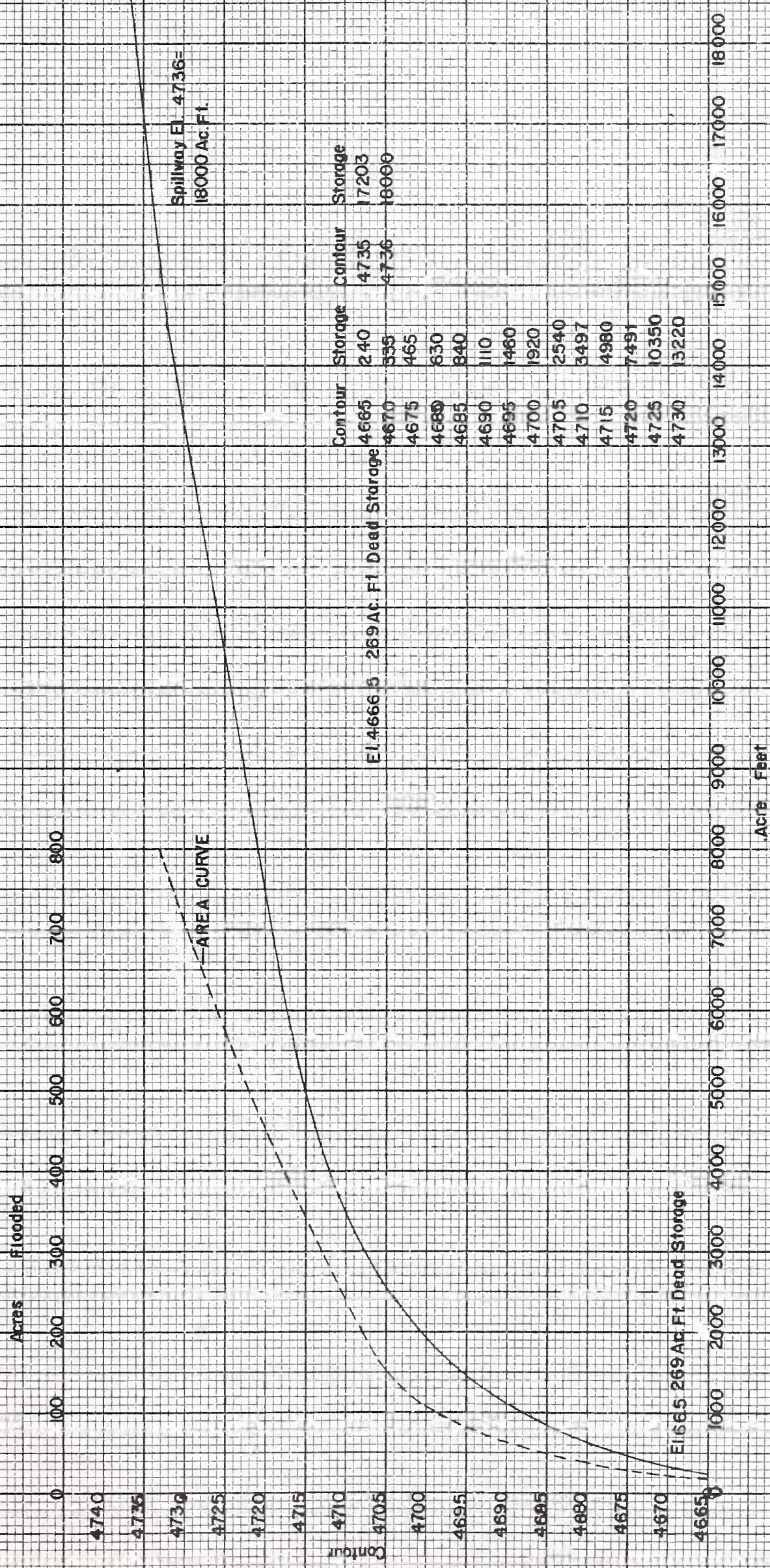
Private diversions

R/W Reservoir Pool  
Reservoir Land

890 acres deeded  
None







WILLOW CREEK RESERVOIR  
 STORAGE CURVE  
 MADISON & GALLATIN COUNTY PROJECT NO. 47





# Yellowwater

The Yellowwater Project consists of a storage reservoir and a canal ten miles southwest of Winnett in Petroleum County. Financing for construction of the project came from SWCB funds.

The 1974 dam safety inspection resulted in the recommendation that a protective coating be applied to the outlet tunnel. A covering over the gate shaft has also been recommended so that rocks or sticks cannot be thrown into the shaft where they could become lodged under the gate, preventing its closure.

During the 1976 annual inspection, holes were found in the corrugated metal pipe outlet below the operating gate. Material had been eroded from below the pipe, leaving a large hole. The water users are now investigating several alternative solutions to the problem.

## Water Measurement

Water deliveries are made under cooperation of the five water users without the aid of measuring devices.

## Engineering Data

### DAM:

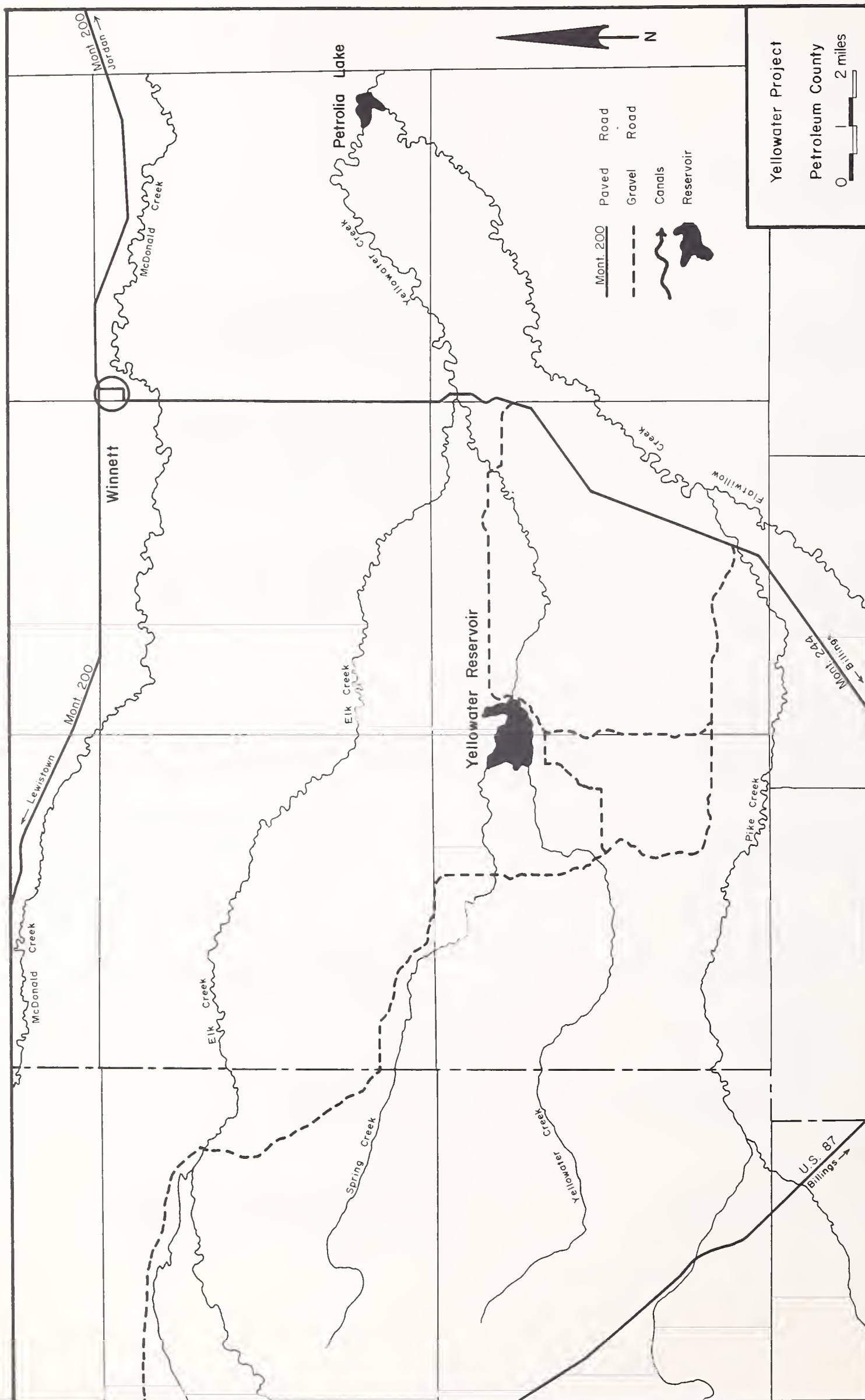
Storage	4,242 acre-feet
Spillway	Width: 100'
	Capacity: 4,000 cfs
Gates	1 42" diameter slide gate. Wet tower.
Height	37'
Length	2,400'
Type	Earthfill, 123,700 cu. yds.
Content Measuring Device	Tape in tower

### CANALS:

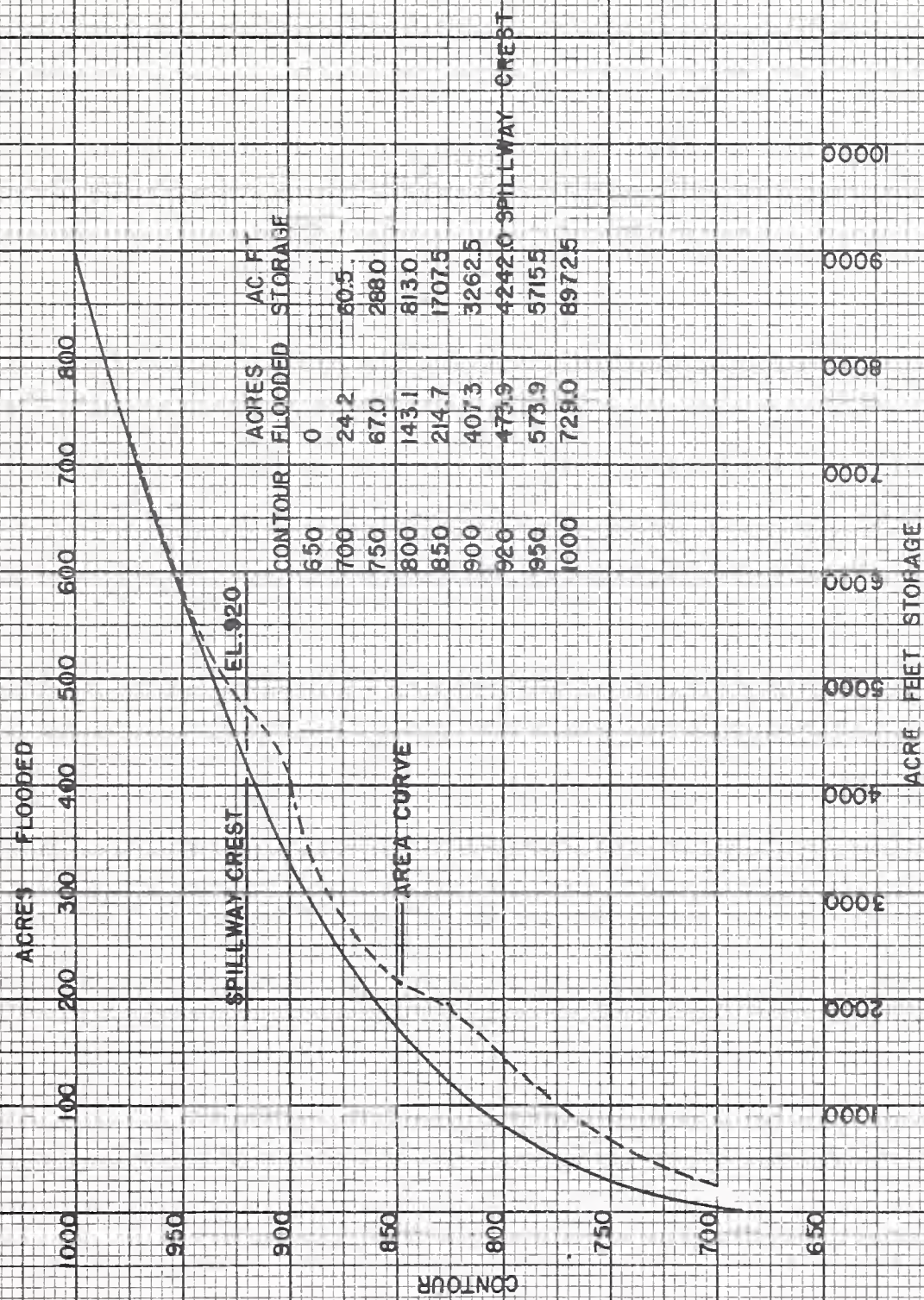
None

R/W	Reservoir Pool	473 acres partially deeded
	Reservoir Land	256 acres partially deeded









# YELLOWWATER RESERVOIR

STORAGE CURVE  
PETROLEUM COUNTY PROJECT NO. 166







# APPENDIX



MASTER LIST OF PROJCTS SORTED BY NAME

PROJ NO	NAME	BASN	CNTY	SEC	TWSP	RNGE	RELEASE DATE	DEEDS	EASEMENTS	COMMENTS
277	ACKLEY LAKE	41S	JB	22	14N	14E		4	47	
117	RAINVILLE	40S	RO		27N	57E			19	ALSO TNSP 28N-RNG58-59E
270	BIG DRY	40D	GF	11	18N	37E		7	29	SEC 12 ALSO
21	BROADWATER-MISSOURI	41I	BR	7	4N	3E		5	64	
740	CATARACT	41G	MA	23	2S	3W			5	
302	CHARLO	76L	LA	19	20N	20W			2	
121	COLUMBUS	43QJ	ST	6	2S	19E		1	12	
703	COTTONWOOD	43A	PA	1	3N	8E		3		
663	DALY DITCHES	76H	RA	11	4N	21W		2	7	
92	DEADMAN'S RASIN	40A	WH	23	7N	18E		17	46	SEC 23 TO 27
653	DELPHIA MFLSTONE	40C	MU	28	9N	29E			48	
210	FLINT CREEK	76E	GR	5	4N	14W		1	39	
732	FLORENCE CANAL	41K	LC	33	20N	7W			8	
386	FRED BURR	76H	RA	14	7N	22W			6	
714	FRENCHMAN	40L	PH	23	34N	34E		5		
119	GREENMOUNTAIN	76N	SA	20	25N	31W			2	
189	HOTCHKISS	42C	RS	22	1S	44E			6	
129	HYSHAM	42KJ	TR	22	6N	35E		2	41	
482	LEWISTOWN DITCH	41S	FE	10	15N	18E			37	
254	LISK CREEK	40P	MC	14	16N	46E			7	
278	LITTLE DRY	40D	GF	4	15N	43E			11	
233	LIVINGSTON DITCH	43B	PA	11	3S	9E			60	
422	MIDDLE CREEK	41H	GA	15	4S	6E		1	9	SEC 16 ALSO
182	NEVADA CREEK	76F	PW	11	12N	10W		2	15	SEC 14 ALSO
649	NEVADA NORTH CANAL	76F	PW	32	13N	10W			11	
73	NILAN	41K	LC	17	20N	7W		3	5	
82	NO FK OF SMITH RIVER	41J	ME	17	10N	8E		2	4	SEC 20 ALSO
577	NORTH WINIFRED	41T	FE	27	21N	18E			7	
257	PAINTED ROCKS	76H	RA	26	1S	22W		10	3	
734	PARADISE CANAL	43B	PA	14	5S	8E			17	
225	PARK BRANCH	43B	PA	4	6S	8E			37	
676	PETROLIA	40B	PF	25	14N	27E		2	6	
250	RED BUTTE CREEK	42L	FA	16	7N	59E		2	5	
64	ROCK CREEK	43D	CA	36	4S	20E		13	10	COONEY DAM-GLACIER LAKE
78	RUBY RIVER	41C	MA	8	7S	4W		5	6	
207	SIDNEY	42M	RI		22N	60E			19	
536	SOUTH SIDE CANAL	41J	ME	26	10N	7E			2	
404	THEBOE LAKE	410	TE	36	24N	8W				
29	TONGUE RIVER	42B	BH	13	8S	40E		2	4	ALSO SEC 18-RNG 41E
214	UPPER MUSSELSHELL	40A	WH	18	8N	12E		35	46	PARTLY IN MEAGHER CO
43	VALFNTINE	40C	FE	20	18N	26E		9		
A625	VIGILANTE CANAL	41C	MA		7S	4W		4	25	
B625	WEST BENCH CANAL	41C	MA		7S	4W			4	
98	WARHORSE	40R	PE	27	16N	25E		2		
47	WILLOW CREEK	41G	GA	26	1S	1W		4	3	
166	YELLOWWATER	40B	PE	7	13N	26E		3		



# WATER RIGHTS SUMMARY

PROJECT	COUNTY	STREAM	DATE OF APPROPRIATION	AMOUNT <sup>a</sup>	COMMENTS
Ackley Lake	Judith Basin	Judith River	8-20-1935	4,000 MI	Filed <sup>b</sup>
Bainville	Roosevelt	Shotgun Creek			No record available
Big Dry	Garfield	Big Dry Creek	10-7-1936	All unap- propriated waters	Filed
Broadwater-Missouri	Broadwater	Missouri Creek	6-28-1938	16,000 MI	Filed
Cataract	Madison	Cataract Creek			No record available
Charlo	Lake	Well	1-01-1948	93 gpm	Filed
Columbus	Stillwater	Yellowstone River and tributaries	9-01-1937	All unap- propriated waters	Filed
Cottonwood	Park	Cottonwood Creek and tributaries	6-23-1953	All unap- propriated waters	Filed
Daly Ditches	Ravalli	Bitterroot River <sup>c</sup>	6-01-1885 to 4-15-1889	11,600 MI	Decreed <sup>d</sup>
		Skalkaho Creek <sup>c,e</sup>	6-15-1865 to 5-01-1891	9,541 MI	Decreed Some water users also have exchange rights from Skalkaho Creek for 3,161 MI; Daly Ditches Project exchanges this for Bitterroot River water.
		Girds Creek <sup>c</sup>	1868 to 6-26-1894	1,700 MI	Filed

PROJECT	COUNTY	STREAM	DATE OF APPROPRIATION	AMOUNT <sup>a</sup>	COMMENTS
Deadman's Basin	Wheatland, Golden Valley & Musselshell	S. Fk Skalkaho Creek Reservoir #1	1912	180 AF	Water rights based upon use and USFS Permit
		S. Fk Skalkaho Creek Reservoir #2	1912	60 AF	Water rights based upon use and USFS Permit
		N. Fk Skalkaho Creek Reservoir #3	1912	200 AF	Water rights based upon use and USFS Permit
Delphia-Melstone	Musselshell & Rosebud	Musselshell River	4-2-49	10,000 MI	Filed
Flint Creek	Granite	Unnamed canal	10-22-1935	All unappropri- ated & surplus waters	Filed
		East Fork of Rock Creek	10-22-1935	"	Decreed
		Cow Creek, Fred Burr Creek, E. Fk. Trout Creek, Trout Creek & Haystack Gulch & their trib., North, South, & Middle Fork of Willow Creek, unnamed canal, unnamed coulees & Flint Creek & its tributaries	3-18-1936	"	Filed

PROJECT	COUNTY	STREAM	DATE OF APPROPRIATION	AMOUNT <sup>a</sup>	COMMENTS
Florence Canal		Douglas Creek	6-12-1944	300 MI	Filed
		Flint Creek	6-12-1944	600 MI	Filed
	Lewis & Clark	Smith Creek			Uses water from Nilan Project
Fred Burr	Ravalli	Fred Burr Creek	6-01-1870	60 MI	Decreed
		Fred Burr Creek	5-25-1946	All unappropri- ated waters	Filed
Frenchman	Phillips	Frenchman Creek	7-25-1950	All unappropri- ated waters	Filed
Green Mountain	Sanders	Swamp Creek	5-18-1939	All unappropri- ated waters	Filed
Hotchkiss	Rosebud	Tongue River			No record available
Hysham	Treasure	Yellowstone River & tributaries	9-19-1945	200 cfs	Filed
Lewistown Ditch	Fergus	Big Spring Creek	6-08-1891	3,000 MI	Filed
		Big Spring Creek	12-18-1911	2,000 MI	Filed
		Big Spring Creek	9-23-1936	5,000 MI	Filed
Lisk Creek	McCone	Lisk Creek	10-19-1936	All unappropri- ated waters	Filed
Little Dry	Garfield	Little Dry Creek	8-29-1936	2,000 MI	Filed



PROJECT	COUNTY	STREAM	DATE OF APPROPRIATION	AMOUNT <sup>a</sup>	COMMENTS
Livingston Ditch	Park	Yellowstone River	8-08-1890	6,000 MI	Filed
		Yellowstone River	12-14-1900	500 MI	Filed
		Yellowstone River	5-19-1903	6,000 MI	Filed
		Yellowstone River	5-01-1936	77 cfs	Filed
Middle Creek	Gallatin	Middle Creek (Hyalite Creek)	7-12-1938	All unappropri- ated waters	Filed
Nevada Creek	Powell	Nevada Creek	9-01-1937	All unappropri- ated waters	Filed
Nevada North Canal					Uses water from Nevada Creek Project
Nilan	Lewis & Clark	Ford Creek & tributaries	8-22-1950	All unappropri- ated waters	Filed
		Smith Creek & tributaries	8-22-1950	All unappropri- ated waters	Filed
North Fork of Smith River	Meagher	North Fork of Smith River	8-20-1935	All unappropri- ated waters	Filed
North Winifred	Fergus	Homestake Creek			No record available
Painted Rocks	Ravalli	West Fork of Bitterroot River	None	None	
Paradise Canal	Park				Uses water from Park Branch Project

PROJECT	COUNTY	STREAM	DATE OF APPROPRIATION	AMOUNT <sup>a</sup>	COMMENTS
Park Branch	Park	Yellowstone River	10-23-1935	250 cfs	Filed. In addition, the Department acquired all of the Park Branch Co.'s rights through a deed dated May 5, 1936.
Petrolia	Petroleum	Johnson Coulee & tributaries	7-19-1947	All unappropriated waters	Filed
		Elk Creek, Flatwillow Creek & tributaries	3-31-1950	All unappropriated waters	Filed
		Flatwillow Creek	3-31-1950	All unappropriated waters	Filed
		Red Butte Creek	8-29-1936	472 AF	Filed
Rock Creek	Carbon	Willow Creek	5-01-1896	150 MI	Decreed
		Willow Creek	5-01-1896	100 MI	Decreed
		Rock Creek (Glacier Lake Reservoir)	5-10-1934	All unappropriated waters	Filed
Ruby River	Madison	Red Lodge Creek (Cooney Reservoir)	5-10-1934	All unappropriated waters	Filed
		Garden Creek	5-15-1880	All waters	Decreed
		Certain Spring & Lake	4-26-1892	100 MI	Decreed

PROJECT	COUNTY	STREAM	DATE OF APPROPRIATION	AMOUNT <sup>a</sup>	COMMENTS
Sidney	Richland	West Fork of Ruby River	9-03-1928	200 MI	Decreed
		Ruby River & tributaries	4-08-1938	All unappropriated waters	Filed
		Yellowstone River & tributaries	9-01-1937	All unappropriated waters	Filed
		Yellowstone River & tributaries	12-15-1938	All unappropriated waters	Filed
South Side Canal	Meagher	North Fork of Smith River			Uses water from North Fork of Smith River Project
Theboe Lake	Teton	South Fork of Willow Creek	12-02-1936	All unappropriated waters	Filed
Tongue River	Big Horn, Rosebud & Carter	Tongue River	4-19-1937	All unappropriated waters	Filed - in Rosebud County.
Upper Musselshell	Meagher & Wheatland	Tongue River	1-31-1938	All unappropriated waters	Filed - in Big Horn County
		North Fork of Musselshell River (Martinsdale Reservoir)	4-22-1938	All unappropriated waters	Filed
		South Fork of Musselshell River (Martinsdale Reservoir)	4-22-1938	All unappropriated waters	Filed



PROJECT	COUNTY	STREAM	DATE OF APPROPRIATION	AMOUNT <sup>a</sup>	COMMENTS
		North Fork of Musselshell River (Durand Reservoir now called Bair Reservoir)	4-22-1938	All unappropri- ated waters	Filed
Valentine	Fergus	Blood Creek & tributaries	11-30-1935	Flood waters	Filed
Vigilante Canal	Madison				Uses water from Ruby River Project
Warhorse	Petroleum	Duck Creek	11-16-1909	200 MI	Filed
		Ford Creek	8-08-1911	20,000 MI	Filed - Acquired from Winnett Irrigation Co. 12-20-1934
		Ford Creek	8-18-1911	10,000 MI	"
		Certain Dry Coulee	12-30-1911	2,500 MI	"
		Buffalo Creek	8-09-1914	20,000 MI	"
West Bench Canal	Madison				Uses water from Ruby River Project
Willow Creek	Gallatin & Madison	Willow Creek	8-20-1935	All unappropri- ated waters	Filed in Gallatin County

PROJECT	COUNTY	STREAM	DATE OF APPROPRIATION	AMOUNT <sup>a</sup>	COMMENTS
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Yellowwater		Norwegian Creek	8-20-1935	All unappropriated waters	Filed in Madison County
	Petroleum	Yellowwater Creek & tributaries	11-27-1935	All unappropriated waters	Filed

WATER RIGHTS SUMMARY  
FOOTNOTES

a. The amounts contained in this column are listed in the units in which they were filed, even though the project water may be charged by the acre-foot, by the acre, or by the miner's inch.

Abbreviations used:      MI = miner's inches  
                                      gpm = gallons per minute  
                                      AF = acre-feet  
                                      cfs = cubic feet per second

- b. The water rights are on file, usually in the courthouse of the county in which the project is located.
- c. The Bitterroot River, Skalkaho Creek, and Girds Creek of the Daly Ditches Project contain numerous individual appropriations; therefore the dates of the earliest and latest appropriations are recorded along with the total amount of appropriation. The Bitterroot River contains two individual appropriations, Skalkaho Creek twenty-four, and Girds Creek six.
- d. A court decision has determined the water rights for the stream. Often the stream withdrawals are overseen by a water commissioner. A decreed stream is also referred to as an adjudicated stream.

- e. Exchange water rights from Skalkaho Creek that are used by the Department of Natural Resources and Conservation on this project are too numerous to mention here, but are on file in the Department's office. However, these exchange water rights total 3,160,986 miners inches and are used on higher lands, mainly through the Ward, Skalkaho, and Hi-Line Ditches. The owners of these exchange rights have land which is located below the Republican and Hedge Ditches and is supplied with equivalent water from these ditches.
- f. All the streams listed under this portion of the Flint Creek Project have the same date of appropriation (3-18-36) and have the same amount of appropriation (all unappropriated and surplus water).



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